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College and University Teachers

There have been numerous recent efforts to appraise our future needs for elementary- and secondary-school teachers. Perhaps the White House Conference on Education did more to make widespread the awareness of the critical need for teachers than any other single event [see *Science* **122**, 1165 (1955)]. The planners of the White House Conference deliberately avoided discussions of higher education in order to concentrate on elementary- and secondary-school problems. But higher education also faces shortages and has serious financial and recruitment problems. Two recent studies have helped to focus attention on these problems.

The relative decline in the income of college teachers compared with other groups in our society has been demonstrated in *Teaching Salaries Then and Now* (Bulletin No. 1, Fund for the Advancement of Education, New York, October 1955). It is a fair assumption that there must be marked improvement in salaries if college teaching is to attract its necessary proportion of talented college graduates in the future. The recent munificent gift by the Ford Foundation of some $200 million to private colleges and universities for the improvement of salaries will help substantially.

Our information has been deficient with respect to the present composition of our faculties of higher education, in age, in sex distribution, and in previous experience. The National Education Association has performed an important service by preparing the most extensive survey to date about full-time and new college teachers (*Teacher Supply and Demand in Degree-Granting Institutions, 1954–55*, Research Bulletin 33, No. 4, December 1955). Data from 61,667 faculty members in 673 institutions showed the median age to be 43.1 years. About 44 percent are 45 or older, and many of this age group will be retired by the time the bumper crops of around 4 million children a year born since 1950 reach college.

The percentage of women teachers in higher education was 21.9 percent in 1954–55, but among new teachers the percentage increased slightly to 23.7 percent in 1953–54 and to 24.1 percent in 1954–55. Is it too much to hope that the increasing demand for teachers will lead to a greater acceptance of women on college and university faculties? Such a change in attitude would obviously make possible some reduction in the expected shortages and would represent a better use of intellectual resources.

The NEA study defines a new teacher as "a regular full-time teacher, not having been so engaged the preceding academic year." Only slightly more than half of the new teachers (51.5 percent) came directly from graduate school; 22.2 percent came from some other educational service, mainly elementary- and secondary-school teaching; the rest from business, government service, the military services, and so on.

These studies solve no problems about the future of higher education, but, by laying a groundwork of quantitative information, give a basis for planning comparable to that already developed in engineering, medicine, and elementary- and secondary-school education. It would not be wholesome to divert any large number of talented people from one field to another; the solution would seem rather to lie in a general increase in the proportion of able students who go on to higher education, coupled with whatever adjustments in salary and status are necessary to keep the numbers going into various fields in balance.—G. DuS.

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Absorption and Metabolism of Iron

Clark J. Gubler

Iron was one of the first nonprecious metals to be known and used by man. Soluble iron salts were used medicinally in early times because it was thought that the iron would impart to the recipient the physical strength associated with the metal. Iron in various forms is still a very important medicinal, but its use is now based on a knowledge of its physiological functions and requirements. It has been common knowledge for many years that iron is an essential component of the hemin chromoproteins—hemoglobin, myoglobin, catalase, the cytochromes, and peroxidase—all of which play an essential role in the transport and utilization of oxygen for energy requirements.

In the years that have intervened since the discovery of the essential role of iron in these systems, a tremendous number of papers have appeared that deal with various aspects of this subject. Since it is not possible here (*1*) to discuss adequately this large volume of literature, the following remarks will of necessity be of a general nature; reference should be made to specific papers for more detail. References to these can be found in recent reviews of iron metabolism (*2–7*).

Dietary Sources of Iron

The total iron content of a foodstuff or diet can be readily determined, and such values for most common foods are found in numerous dietary tables (*8*). These figures, however, do not tell us what proportion of the total iron is potentially available for use by the body after ingestion of a particular food. The latter value is dependent on a number of factors that will be discussed here. Thus, a food high in iron may not necessarily be a good source of biologically available iron.

Dietary iron may be divided roughly into two fractions: (i) that which can be readily converted into ionized form by the action of dilute acids and (ii) that portion which resists ionization under these conditions. The latter fraction is composed chiefly of iron porphyrins and other complexes in which iron is firmly bound with organic molecules. These must be partially or completely broken down before the iron becomes ionizable. In the older terminology, the term *available iron* referred to that iron which was ionizable by treatment with dilute acid and, hence, would react with α,α'-dipyridyl on reduction (*9*). However, the "availability" of iron in a food, as determined by the *in vitro* α,α'-dipyridyl test, is of limited physiological significance. The iron in an inorganic salt, which would be rated as 100 percent available by this test, may be "physiologically available" to the extent of only 5 to 40 percent, depending on a variety of other conditions. It is also known that variable amounts of the so-called "nonavailable" iron may be absorbed and utilized (*10*).

Absorption of Iron

Factors influencing iron absorption. The chemical nature of the iron occurring in foods is probably of less importance in determining its physiological availability than a variety of other factors that exert a favorable or unfavorable influence on its absorption from the gastrointestinal tract. Some of the most important of these follow.

1) Divalent iron (ferrous) is generally absorbed to a greater extent than trivalent (ferric) (*11*). This is undoubtedly partially owing to the greater solubility of ferrous complexes with a variety of inorganic and organic anions and of ferrous hydroxide as compared with the corresponding ferric compounds. Thus, the availability of reducing mechanisms in the environment will determine the proportion of ferrous iron and, hence, the degree of absorption of the iron ingested. These reducing mechanisms may be supplied in the various digestive juices or they may come from the diet in the form of ascorbic acid, sulfhydryl compounds, and so forth (*12*). The sulfhydryl groups liberated by protein hydrolysis during digestion may also contribute substantially to this reducing medium.

2) There is an inverse correlation, other things being equal, between the size of dose and the percentage of the dose that is absorbed. On the other hand, the total amount of iron absorbed depends on the dose. Thus, if a 100-milligram dose of iron is fed, only 10 percent may be absorbed, but this would represent 10 milligrams of iron; whereas after the feeding of 10 milligrams of iron, 20 to 30 percent (or only 2 to 3 milligrams) may be absorbed. With small doses, then, the efficiency of absorption may be greater, but the total amount absorbed may be entirely inadequate to meet the requirements. Therefore, in clinical therapy with iron, the practice is to give as large a dose as can be tolerated. A common mistake in the treatment of iron deficiency states is the discontinuance of therapy with iron as soon as the hemoglobin attains normal levels but before the iron deficit in the tissues has been replaced.

3) In an acid medium (pH below 5), the iron in foods and in ferric hydroxide is converted to the soluble ionic form, and the formation of insoluble and undissociated complexes is inhibited. The reduction of ferric ions to the ferrous form by ascorbic acid, sulfhydryl groups, and so forth, also takes place more readily at acid pH. For these reasons, the acidity of the gastric juice may exert a favorable influence on iron absorption (*13*). However, if it exerts a significant influence, it must be looked upon as only one of several contributory factors since

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not all patients with achlorhydria become iron deficient, and not all cases of iron deficiency have achlorhydria. Thus, achlorhydria alone will rarely lead to iron deficiency without the intervention of other factors that either increase the requirements or decrease the amount of iron available (*7, 14*). Iron absorption takes place largely in the stomach and duodenum (*15*).

4) Since ferric iron readily forms insoluble and undissociable complexes with phosphate ions, the presence of much phosphate in the diet can materially reduce the absorption of iron. Conversely, diets lacking or very low in phosphates can lead to excess iron accumulation in the body (hemosiderosis) (*16*). Calcium in moderate amounts can have a favorable effect on iron absorption by combining with the phosphate ions. On the other hand, if excessive amounts of calcium are present in the diet, the absorption of iron is inhibited, which gives rise to an iron-deficiency anemia.

5) Phytic acid, by virtue of its ability to form insoluble iron complexes, also inhibits iron absorption. This may be reversed by calcium, which ties up the phytic acid. Many other organic acids occurring in foods or their digestion products form insoluble or undissociated iron complexes, chiefly with ferric ions, and thus exert an inhibiting effect on iron absorption (*17*). This is probably the reason that lower absorption of iron occurs when it is taken along with food than occurs when it is taken without food. It has been shown that pyridoxine influences iron absorption. In pyridoxine deficiency, the absorption of iron is increased (*18*). Copper is another dietary essential that influences iron absorption. A deficiency of copper lowers iron absorption in animals (*19*).

Regulation of iron absorption. The concept of the regulation of iron absorption is comparatively recent. Even as late as 1937, it was generally thought that iron, in common with most other heavy metals, was absorbed more or less indiscriminately from the gastrointestinal tract and that excretion through the colon maintained iron balance and prevented overloading of the body with iron.

McCance and Widdowson (*20*) first introduced the concept that the intestine in some manner controls the amount of iron absorbed. With the advent of more refined methods based on the use of radioactive isotopes of iron, it has been shown that the excretion of iron is negligible (*21*) and hence that there must of necessity be some mechanism for regulating iron absorption to prevent toxic accumulation of the element (*2–7*). In man and animals that have been made anemic by bleeding, the amount of iron absorbed from a given dose increases 5 to 15 times over the amount absorbed before bleeding. However, the degree of iron absorption is not increased until 6 to 7 days after an acute massive hemorrhage (*15*). This suggests that the intestinal mucosa does not respond immediately to a reduced hemoglobin level with an increase in absorption but must wait until the body stores have been depleted by accelerated hemopoiesis or until some other factors are activated. There is evidence that chronic low levels of hemoglobin do lead to increased iron absorption even in the face of adequate or excessive storage iron (*22, 23*).

Prolonged anoxia and the level of the plasma iron and iron-binding B_1-globulin have not been shown to play a significant role in the regulation of the absorption of iron. The regulatory mechanism normally seems to be most closely correlated with the body stores of and requirements for iron. This has given rise to the so-called selective or "intestinal intelligence" theory of the regulation of iron absorption, wherein the ability to select or reject iron according to the body needs is ascribed to the intestinal mucosa (*15*).

Since a single large dose of oral iron will inhibit or block iron absorption for a period of several days, the idea of a "mucosal block" was advanced to describe this phenomenon. According to this theory, an acceptor is present in the intestinal mucosa that is capable of combining with iron that comes into the mucosal cells. When the acceptor is saturated with iron, no more iron can pass through the cells until some of the acceptor is made available again by removal of the iron. It has been claimed that the protein, apoferritin, is such an acceptor (*24, 25*). This protein is able to accept iron in the ferric form to become ferritin. Normally, there is no demonstrable apoferritin and there are only small amounts of ferritin present in the mucosa. After iron-feeding, the amount of ferritin in the upper gastrointestinal mucosa, and particularly in the duodenal mucosa, is increased considerably (*25*). This disappears gradually over a period of several days.

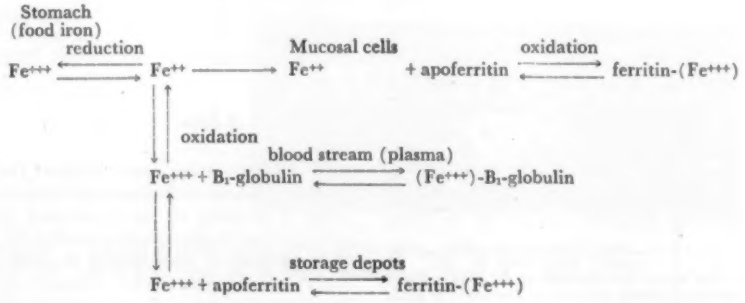
This sequence of events closely parallels the development of the "mucosal block" after an oral dose of iron. The acceptor, apoferritin, does not accumulate in anticipation of iron availability but is synthesized as the need arises. Whether the iron itself is the agent that initiates this synthesis or whether it is some other substance has not been clarified. Granick (*3*) explains this theory diagramatically as shown at the bottom of the page.

Iron passes into the mucosal cell in the form of ferrous ion. Within the cell the ferrous ion (Fe^{++}) is in equilibrium with the ferric iron stored as ferritin. When more iron is required in the body as a result of depletion of the iron stores, ferrous iron is drawn from the mucosal cell. Only when the mucosal cell ferritin-Fe^{+++} has decreased to a point where the cell is no longer "physiologically saturated" with Fe^{++} does absorption commence. This suggested mechanism provides the most satisfactory explanation available at present for the regulation of iron absorption. However, it must be regarded in relative rather than absolute terms because persons with adequate and even excess iron stores may absorb appreciable amounts of iron.

Pathology of iron absorption. The afore-mentioned mechanism of selective iron absorption breaks down under a variety of pathological conditions. Thus, in hemolytic and pernicious anemia, pyridoxine deficiency, and in some other conditions where the storage iron is known to be adequate or even excessive, iron absorption continues at an increased rate (*18, 22*). The condition known as hemochromatosis is probably the result of inborn error of iron metabolism that allows iron to be absorbed in excessive amounts despite a plethora of iron in the tissues. This results in the accumulation of massive quantities of iron over a period of years. The exact nature of the defect in the regulatory mechanism in this condition is not known (*26, 27*).

Excretion of Iron

Iron is normally excreted in very small quantities. In man, the combined excre-



tion by all routes (urine, bile, sweat, intestines, loss of hair, desquamation of body cells, and so forth) amounts to about 0.5 to 1.5 milligrams per day (*14*). In nephrosis, the excretion of iron in urine may be as high as 1.5 milligrams per day, depending on the quantity of protein excreted. This iron is excreted chiefly as an iron-B_1-globulin complex (*28*).

Iron Transport

Absorbed iron passes through the mucosal cells directly into the blood stream. Very little is absorbed by way of the lymphatic system (*29*). The plasma is the chief medium for iron transport. Ferrous iron entering the plasma is quickly oxidized to the ferric form by the dissolved oxygen (*30*). This ferric iron then forms a complex with a specific B_1-globulin (siderophillin, transferrin, metal-binding globulin) in which form it is transported to various parts of the body as required. This combination can take place either *in vivo* or *in vitro* after addition of iron to plasma (*26, 31, 32*).

The Fe^{+++}-B_1-globulin complex has a characteristic salmon-pink color with a maximum light absorption at 520 millimicrons, and this property has made possible the development of simple methods for the measurement of the available iron-binding capacity of the plasma (or serum). Iron that is added to the plasma in excess of this physiological iron-binding capacity is bound more loosely than the B_1-globulin-iron and in a nonspecific manner with other plasma proteins, and the complexes formed do not absorb light at 520 millimicrons. This loosely-bound iron is very rapidly removed from the plasma *in vivo* and it is this fraction that causes toxic reactions in the organism after the injection of larger doses of ionizable iron compounds.

The mean of the plasma (or serum) iron values taken from 13 different groups of normal human subjects is 129 micrograms per 100 milliliters for men and 110 micrograms per 100 milliliters for women (*33*). The specific iron-binding B_1-globulin makes up about 3 percent of the total serum proteins, or 0.26 gram per 100 milliliters of serum. Since two molecules of iron combine with a single molecule of protein (molecular weight, 90,000), this makes a total iron-binding capacity of 300 to 350 micrograms of iron per 100 milliliters of serum. Thus, the B_1-globulin is normally about 33 percent saturated with iron. In cases of iron need (iron-deficiency, chronic hemorrhage, and so forth), the total capacity to bind iron increases and the degree of saturation decreases markedly. On the other hand, a plethora of iron in the storage depots is associated with a decrease in the total iron-binding capacity and a marked increase (up to 100 percent) in the degree of saturation. In conditions such as infection and malignancy, the total iron-binding capacity is decreased and the serum iron is also decreased. This results in a degree of saturation only slightly below normal.

Although the plasma iron makes up only 0.1 percent of the total iron circulating in the blood, it is a very important fraction and serves as a sensitive index of the state of iron metabolism in the body as illustrated by Fig. 1.

As shown in Fig. 1, the plasma iron level at any moment is the resultant of a number of factors and will depend on which of these factors assumes the greatest relative importance at the time. For example, if absorption is decreased, the plasma iron level will decrease unless this change is compensated for by decreased utilization, increased destruction, or decreased storage. On the other hand, if blood destruction is increased, the plasma iron will increase unless this is counterbalanced by increased utilization and/or storage. Excretion plays an insignificant role under most circumstances.

Whole blood normally contains 40 to 50 milligrams of iron per 100 milliliters. Of this 99.9 percent is in the form of hemoglobin, an iron-porphyrin (heme)-protein complex with a molecular weight of 68,000 and iron content of 0.34 percent. Each molecule is composed of four units of 16,000 molecular weight each containing one heme and one molecule of globin. Hemoglobin has the unique property of combining reversibly with oxygen at the O_2-tension in the lungs and giving up 70 to 90 percent of this oxygen at the O_2-tension of the tissues. Thus, its chief function is the transport of oxygen to the sites where it is required. In the muscle, this oxygen is accepted by another heme protein, myoglobin, which has a molecular weight one-fourth that of hemoglobin. Myoglobin functions in oxygen transport and as an oxygen reservoir in the muscle and delivers its oxygen to the cytochrome system and other energy-producing systems of the cell as required. This storage function becomes particularly significant during intense muscular activity.

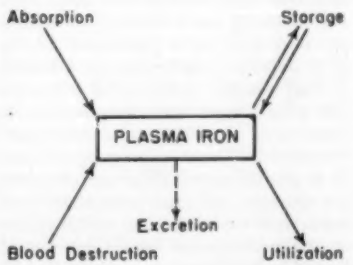


Fig. 1. The plasma iron level is the resultant of a number of factors.

The cytochrome system is composed of the four iron-porphyrin-protein complexes, cytochrome oxidase, and cytochromes *a*, *b*, and *c*. These serve in the stepwise oxidative transfer of electrons through the first steps of their passage from molecular oxygen to the substrates by way of intermediate energy-transfer systems of the cells. This makes possible the utilization of the energy in the foodstuff for the various physiological processes in the body. It is, therefore, evident that iron plays a key role in the most vital processes of the body. Catalase and peroxidase are two more iron-porphyrin-protein enzymes that are present in nearly all tissues. Their exact physiological functions are not clear. Presumably they serve to prevent toxic accumulation of peroxides within the cells.

Iron Storage

The average human body contains approximately 4.5 grams of iron. This can be divided roughly into four main fractions: The hemoglobin, which is found almost entirely in the blood, comprises 72.9 percent of the total. Myoglobin, which is found in muscle tissue, comprises 3.3 percent. Parenchymal iron (including the iron of the cytochromes, catalase, and peroxidase), which is found in all tissues, comprises 0.2 percent. The storage iron (ferritin, hemosiderin, and iron unaccounted for) comprises 23.5 percent, most of which is found in the liver, bone marrow, and spleen (*6*). In the dog, Hahn and coworkers (*4*) found a somewhat different distribution—hemoglobin, 57 percent; myoglobin, 7 percent, parenchymal iron, 16 percent, and storage iron, 20 percent. The myoglobin and parenchymal fractions of iron are less labile than the hemoglobin and storage fractions (*34*).

In the normal adult human being, about 27 to 28 milligrams of iron are released per day by the breakdown of hemoglobin (*6*). In contrast to the porphyrin moiety of hemoglobin, which is further degraded and excreted, very little of the iron is excreted. It is carefully husbanded and reutilized for new hemoglobin synthesis. Iron newly liberated by hemoglobin breakdown is used for resynthesis of hemoglobin in preference to that present in the stores or that which has been newly added by absorption (*35*). Similarly, newly absorbed iron is more readily utilized for hemoglobin synthesis than that already in the storage depots. The preferential utilization of these two fractions of the available iron may best be explained by the existence of a "labile

iron pool" that has been postulated (*7*); it represents a small fraction of the total available iron that is more readily mobilized and selectively utilized for current metabolic needs.

Iron is stored chiefly in the two forms, ferritin and hemosiderin (*24*). Ferritin is the more soluble of the two and can be readily extracted from tissues by water or dilute saline solutions. It consists of a protein moiety, apoferritin, of molecular weight 465,000, that may combine with up to 20 to 23 percent of its weight of iron. The iron in ferritin exists as micelles of ferric hydroxide of peculiar magnetic properties (3 unpaired electrons per iron atom) and configuration. It has the approximate composition $(FeOOH)_8$-$(FeOOPO_3H_2)$. Ferritin, as isolated, is not homogeneous with respect to iron content. The liver contains the highest concentration and the greater part of the total body ferritin; the spleen and bone marrow also contain considerable amounts. The postulated role of ferritin in the regulation of iron absorption has been discussed in a previous section. Ferritin-iron is readily available for synthesis of hemoglobin and other important iron-containing complexes of physiological importance. Ferritin has also been shown to act as an inhibitor of the vasoconstrictor action of epinephrine (*36*).

The other storage form of iron, hemosiderin, was the first to be recognized in tissues, but less is known about its composition and properties. It too contains the iron as ferric hydroxide stabilized by protein. Its iron content may vary from 9 to 55 percent. Hemosiderin remains insoluble under the conditions used for the extraction of ferritin (*37*). Extensive use has been made of this property as a means of separating these two forms of storage iron. The iron of hemosiderin is readily extracted from the insoluble fraction by the use of dilute solutions of strong acids. After the iron has been thus freed, it can be detected by the formation of prussian blue on the addition of potassium ferrocyanide. This is the basis of a commonly used method for the staining of hemosiderin in tissues. Ferritin also reacts in a similar manner, but it is not ordinarily visible microscopically because of its diffuse distribution. Hemosiderin occurs as discrete yellow-brown granules that can often be seen in unstained preparations.

The exact relationship between these two forms of storage iron is still not completely understood. Both forms are present normally, but unless the quantity of storage iron is normal or greater, the hemosiderin cannot be detected by staining methods. When small amounts of iron are presented to the storage tissues, ferritin is probably formed preferentially. When larger amounts of iron are introduced, the ability to synthesize apoferritin and to combine with iron to form ferritin is exceeded, and more iron is stored as hemosiderin. Some of this may later be converted to ferritin. After excessive hemoglobin breakdown and when large amounts of iron are injected parenterally, the storage of iron as hemosiderin is considerable. The amount of hemosiderin in bone marrow aspirates or liver biopsy samples has been used extensively as a rough index of the state of the iron stores in the body (*38*). Only when no hemosiderin can be detected can one expect a response to iron therapy.

Physiological Requirements for Iron

Since iron already present in the body is utilized over and over again, the amount of iron used daily for hemoglobin formation (26 to 27 milligrams) is far in excess of the actual daily requirement for iron in the diet (*6*). This requirement represents only that iron which is lost to the body through excretory channels. Naturally, any iron lost through acute or chronic bleeding will greatly increase the requirement. Barring blood loss, the normal human male excretes about 1.2 milligrams of iron per day. Normal women lose an average of 1 milligram per day in the menses and hence have nearly double the daily iron requirement of men. During pregnancy the loss through menstruation no longer exists, but an average of 2.7 milligrams of iron per day is supplied to the fetus, making a total daily loss to the mother of 3.8 milligrams per day.

Since infants, children, and adolescents are expanding their blood volume and tissue by growth, their iron requirements are much greater than those indicated by the small amounts lost by excretory routes. The increment required for growth in the first 20 years of life amounts to 0.3 to 0.6 milligram per day. As the result of a careful study of iron losses and requirements and multiplication by a factor of 10 to allow for the relatively low absorption of food iron, the following daily dietary allowances for iron have been recommended (*6, 39*): infants, 1 milligram per kilogram of body weight; children, 0.6 milligram per kilogram of body weight; normal adult men, 10 milligrams; normal adult women, 12 milligrams; pregnant women, 15 to 20 milligrams. These are conservative estimates and must be increased considerably if there is evidence of blood loss or of conditions that impair the absorption of ingested iron.

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Gordon Research Conferences

W. George Parks

The Gordon Research Conferences, AAAS, provide opportunities for the advancement of science that are not now available at any other type of scientific meeting. They have been named in recognition of the vision and initiative of the late Neil E. Gordon. The conferences were started in 1931 at Johns Hopkins University under the sponsorship of the department of chemistry. In 1937, when Gordon was secretary of Section C—the conferences were reorganized under the auspices of the American Association for the Advancement of Science. It was Gordon's belief that scientific men and women could profit by knowing each other better and by having an opportunity to discuss their scientific interests in a leisurely and informal manner amid pleasant surroundings. It requires time to grasp thoroughly another person's point of view, and this can best be accomplished by relatively unhurried, friendly exchange of information, with ample opportunity for thought.

It has been the primary purpose of the Gordon Research Conferences to stimulate research in universities, research foundations, and industrial laboratories by an informal type of meeting consisting of lectures and open discussion. Sufficient time is made available to permit ample discussion among the members of the conference. This type of meeting is a valuable means of exchange of information and the stimulation of ideas that are not realized through the normal channels of publication and scientific meetings. Scientists become better acquainted, and valuable associations are formed that often result in collaboration and cooperative efforts between different laboratories.

The program for the summer of 1955 included 36 conferences, 12 at each of the 3 locations—Colby Junior College, New London, N. H.; New Hampton School, New Hampton, N. H.; and Kimball Union Academy, Meriden, N. H. The complete program for each conference, as well as general information on application for attendance, registration, and cost was published in *Science* last spring [**121**, 571 (22 Apr. 1955)].

Attendance at each conference is limited to 100 scientists, who are selected from among those who apply. Selection is based on the expected active participation in the subjects to be discussed. The total attendance at the 1955 conferences was 3,336 scientists, each active in advancing knowledge in the subject of the conference he attended. There were 38 eminent foreign scientists who actively participated in the various conferences. The foreign countries represented were Belgium, Canada, England, France, Netherlands, Italy, New Zealand, Panama, Scotland, and Sweden. Financial assistance for foreign scientists to attend the conferences is provided by grants from the National Science Foundation and the Rockefeller Foundation. There were 5 new conferences held in 1955. These conferences were "Blood," "Plant biochemistry and agriculture," "Glass," "High-pressure research and techniques," and "Fats and oils."

The Gordon Research Conferences are highly regarded by scientists throughout the world. The general pattern of scientific value has been established. Each conference extends the frontiers of science. The purpose of the program is not to review known information, but primarily to bring experts up to date on the latest developments, to analyze the significance of these developments, and to provoke suggestions concerning the underlying theories and profitable methods of approach for making new progress. Information presented at the conferences is not to be used without the specific authorization of the individual who makes the contribution, whether in formal presentation or in discussion. Scientific reports are not published as emanating from the conferences.

The conferences are administered by a Management Committee and a Council. The Council is composed of sponsors' representatives, the conference chairmen, and 15 elected academic members-at-large. The Management Committee is elected by and from the Council. Its members are Arthur K. Doolittle, chairman; Robert W. Schiessler, chairman-elect; John A. Behnke; H. E. Carter; Bernard L. Oser; George Scatchard; and Raymond Stevens.

The topics, dates, and chairmen of the conferences to be held in the summer of 1956 follow.

Colby Junior College

Catalysis, 11–15 June, H. H. Voge; Petroleum, 18–22 June, J. S. Ball; Separation and Purification, 25–29 June, H. G. Cassidy; Polymers, 2–6 July, C. G. Overberger; Textiles, 9–13 July, G. R. Seidel; Corrosion, 16–20 July, J. J. Harwood; Instrumentation, 23–27 July, Donald Williamson; Elastomers, 30 July–3 Aug., B. S. Biggs; Food and Nutrition, 6–10 Aug., Robert A. Harte; Vitamins and Metabolism, 13–17 Aug., Karl Folkers; Medicinal Chemistry, 20–24 Aug., Bernard B. Brodie; Cancer, 27–31 Aug., H. S. N. Greene.

New Hampton School

Organic Reactions and Processes, 11–15 June, Robert B. Carlin; Metals at High Temperatures, 18–22 June, V. N. Krivobok; Proteins and Nucleic Acids, 25–29 June, G. B. Brown; Coal, 2–6 July, H. H. Storch; Radiation Chemistry, 9–13 July, R. L. Platzmann; Organic Coatings, 16–20 July, Harry Burrell; Chemistry and Physics of Metals, 23–27 July, Bruce Chalmers; Steroids and Related Natural Products, 30 July–3 Aug., Joseph Fried; Analytical Chemistry, 6–10 Aug., W. D. Cooke; Inorganic Chemistry, 13–17 Aug., John Gall; Statistics in Chemistry and Chemical Engineering, 20–24 Aug., Lee Crump; Adhesion, 27–31 Aug., Richard F. Blomquist.

Kimball Union Academy

Lipids, 11–15 June, E. H. Ahrens, Jr.; Stream Sanitation, 18–22 June, C. N. Sawyer; Nuclear Chemistry, 25–29 June, L. Yaffe; Chemistry and Physics of Isotopes, 2–6 July, T. I. Taylor; Solid-State Studies in Ceramics, 9–13 July, J. R. Johnson; Bones and Teeth, 16–20 July, R. F. Sognnaes; Chemistry at Interfaces, 23–27 July, W. M. Bright; Ion Exchange, 30 July–3 Aug., H. C. Thomas; High-Pressure Research, 6–10 Aug., E. W. Comings; Toxicology and Safety Evaluations, 13–17 Aug., B. L. Oser; Infrared Spectroscopy, 20–24 Aug., E. R. Blout; Glass, 27–31 Aug., O. L. Anderson.

The complete program for each conference will be published in the 2 March issue of *Science*.

The author is director of the Gordon Research Conferences and head of the department of chemistry at the University of Rhode Island.

Pierre Teilhard de Chardin, Paleoanthropologist

The sudden death of Pierre Teilhard de Chardin, S.J., in New York on 11 April 1955 deprived the scientific world of an outstanding expert in the fields of vertebrate paleontology, paleoanthropology, and Pleistocene geology. He was well known, deeply respected, and admired by colleagues in four continents. Born in central France in the Puy-de-Dôme, he was educated at the Jesuit College in Villefranche-sur-Saône. After he had joined the order, he completed his religious studies in Jersey, England, and Egypt between 1904 and 1912. Upon his return to Paris, he worked under Marcellin Boule, director of the Laboratoire de Paléontologie du Muséum d'Histoire Naturelle, who was at that time engaged in intensive research on fossil man in connection with his studies of the skeleton from La Chapelle-aux-Saints. Teilhard's interest in the problems of the evolution of man dates from this time, when he received so much inspiration from so great a teacher. At this time he also published a number of monographs, mainly on the small mammals, carnivores, and primates that had been collected from the Eocene deposits at Quercy and in the Jura.

Just before World War I, while he was in England, Teilhard visited the Piltdown site with Arthur Smith Woodward and discovered a tooth of the so-called "Eoanthropus dawsoni," which was recently found to be the most singularly clever forgery of all time in the field of paleoanthropology.

Teilhard served with a medical corps unit as a stretcher-bearer in France from 1914 to 1918 and was awarded the Médaille Militaire and the Croix de la Légion d'Honneur for distinguished service and bravery—honors which, with all his others, he received with the utmost modesty and characteristic simplicity. When in 1946 he became an Officier de la Légion d'Honneur au Titre des Affaires Étrangères because of his invaluable work in China, and in 1950 and 1951 a corresponding member and a nonresident member of the Académie des Sciences de Paris, he accepted these further outstanding acknowledgments of his brilliant contributions to science with his usual humility, almost never alluding to them.

Before he began his distinguished Asiatic career, Teilhard was awarded his doctorate from the Sorbonne in 1922, and until 1928 he was professor of geology at the Institut Catholique de Paris. With Father Licent he was for 2 years in the Ordos region of North China, where the French Government sent him in 1923, to conduct a highly successful research program. This was followed by an expedition in 1928–29 to Somaliland and Abyssinia. From 1929 until the outbreak of hostilities with Japan in World War II, Teilhard was adviser to the Geological Survey of China at Peking. During these years, he took part in expeditions to the Gobi Desert, to Chinese Turkestan, northern and central India, and Burma and Java. After the war, unable to return to China because of political developments, he visited South Africa twice, and at the time of his death was expressing a hope of going to Formosa in the near future.

The years in China resulted in the most important contributions that were made by Teilhard in the fields of vertebrate paleontology, paleoanthropology, and Pleistocene geology. With his Chinese colleagues, he participated in the excavations at Choukoutien, where *Sinanthropus* was discovered. He followed up his intense work on the material by visits to Java, where he made important observations on the geological provenance of *Pithecanthropus* and *Meganthropus*, as well as related fossil forms. Later, when he went to Africa, he was able to study at first hand the breccias in the Transvaal that have produced the australopithecine remains. His observations were set forth clearly in a series of short papers that were published just before he died.

Teilhard de Chardin's long and invaluably productive life covered a vitally important era in the study of human evolution. When he entered the field before World War I, the study of fossil man was in an extremely elementary and almost amateur stage. During his lifetime, he saw and participated in the rapid development of the allied sciences of Pleistocene geology, vertebrate paleontology, paleobotany, paleogeography, paleoanthropology, and finally the use of radioactive carbon for dating purposes. Always a scientist, but never a skeptic, Teilhard was a man of outstanding integrity in his work and of unfailing kindness to and interest in his younger and less-experienced colleagues. He was a splendid teacher who was clear and succinct in his explanations, which were readily forthcoming whenever he was appealed to for help or advice. Tall, lean, and hard, he was always in excellent physical shape; on an expedition, he was a tower of strength and he quietly and certainly without intention became the central pivot of the staff. Blessed with a gentle but perceptive sense of humor, he was at all times the best of companions, always unselfish, always inspiring, and always ready with information for the furthering of the work at hand.

Above all, Teilhard held strongly to his conviction concerning the spiritual side of man's development. The spiritual side was as vital to him as the purely physical evidence, and in his ability to sustain and teach this belief he was head and shoulders above those of us who are left here to carry on the work and to mourn the passing of a noble scholar and a great gentleman.

HALLAM L. MOVIUS, JR.
Peabody Museum, Harvard University, Cambridge, Massachusetts

A research problem is not solved by apparatus, it is solved in a man's head. . . . The laboratory is the means by which it is possible to do the solving after the man has the idea clarified in mind.—CHARLES F. KETTERING.

G. A. Hulett, Great Experimentalist

George Augustus Hulett was one of the great experimentalists of his generation in American chemistry. Born in Will County, Ill., in 1867 and possessing the vigor and energy characteristic of the Middle West at that time, he attended Oberlin College for 2 years and then transferred to Princeton, where he received his A.B. degree in 1892 and continued his education for 4 years as an assistant in chemistry. He then went to Germany to join the brilliant group of pioneer physical chemists who were studying at Leipzig under Ostwald, the father of modern physical chemistry. Returning to this country with his Ph.D. degree from the University of Leipzig, he served as instructor and assistant professor of physical chemistry at the University of Michigan from 1899 until 1905, when he returned to Princeton as an assistant professor. In 1909 he became the first professor of physical chemistry at Princeton, where he remained for the rest of his long and useful life, which came to an end on 6 September 1955.

The work in Leipzig led to an important paper on the solid-liquid transition. This was followed by what were certainly among his most fundamental contributions, two papers published from the University of Michigan, one on surface tension and solubility, the other on particle size and solubility. The same period included specific solubility investigations and a paper on the relationship between negative pressure and osmotic pressure. His publications soon showed his developing interest in the subject of standard cells, a field that was to hold his attention for many years. These researches not only led to a voltage standard of remarkable reproducibility and constancy, but also involved fundamental investigations of the inorganic chemistry of the component substances of the cells and of the thermodynamics of cell processes. Precise work on the silver coulometer and voltameter was a natural outgrowth of his electrochemical researches. His interests, developed as a consultant for years and as chief chemist for 1 year of the U.S. Bureau of Mines, were reflected in researches on coal, charcoal, graphite, and graphitic acid. A keen and active mind combined with great experimental ingenuity produced a varied pattern of research that included minor but very useful investigations such as a very simple method for the extreme purification of mercury and the preparation of standard hydrochloric acid from a constant boiling solution. An ingeniously simple apparatus devised for one purpose might be converted to use for a quite different objective. An apparatus that consisted of little more than a test tube closed by a small cup of carbon dioxide, solidified in the laboratory, provided a very sensitive means for the determination of the moisture content of a variety of different materials, including coal and cereals.

At a time when the staffs of university laboratories did not include professional glass blowers, Hulett was the one expert glass blower in the Princeton community; as such, he was not infrequently imposed on by his scientific colleagues. His driving energy made him a very rapid worker. He would devise and build, and, sometimes, break and rebuild an apparatus in the time required by an ordinary man for the initial stages of construction. A new graduate student beginning his first research would be surprised at the philosophical tolerance with which his professor would receive the news of an accident to apparatus. The damage would soon be repaired.

Although Hulett worked night and day in the laboratory and never spared himself, his zest for living and his capacity for friendship won him a wide circle of friends, among whom his graduate students were always numbered. His society membership included the American Philosophical Society and the National Academy of Sciences and his activities were many. In 1917 he went to France as a member of the Foreign Service Commission of the National Research Council and spent 4 months, mostly at the battle fronts of the French and English, studying the organization and development of scientific activities in connection with warfare. He returned to this country to organize a research unit for the Chemical Warfare Service at Princeton.

Always unsparing of himself, he refused on one occasion to give in to an illness that developed into a case of pneumonia so severe that no ordinary man would have survived. Although he recovered from this illness and returned to his usual activity, he suffered a crippling concussion in 1920 in a fall that greatly handicapped him in subsequent experimental work. However, he published a considerable number of papers after this and served as associate editor of the *Journal of Physical Chemistry*, as vice-chairman and then chairman of the division of chemistry and chemical technology of the National Research Council, and as chairman of the division of the origin and classification of coal at the International Coal Conference that was held at Pittsburgh, Pa., in 1931. Even after he became professor emeritus in 1935, he continued to come to the laboratory for some years until increasingly bad health curtailed his activities more and more. In 1954 the Huletts' golden wedding anniversary marked the completion of 50 years of a particularly close and devoted family life in which their one son, George Barker Hulett, had shared.

CHARLES P. SMYTH

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I take the view that a theory should be a policy and not a creed, that its most important work is to suggest things which can be tried by experiment, and for this the theory should be one that is easily visualized.—J. J. THOMSON.

News of Science

German Atomic Energy Center

A documentation center for literature on atomic energy and radioactive isotopes has been opened in the House of Technology in Essen, Germany. About 70 scientists have volunteered to assist in collecting, sorting, and evaluating specialized material for the center. Pertinent foreign publications are to be translated into German, completely or in part.

Later, courses are to be held for training employees of industry in nuclear physics. Such courses are to include an introduction to the construction and operation of the approximately 20 types of atomic reactors now in existence; instruction on the production of isotopes; ways of destroying or using radioactive fission products; and information on German liability laws in the sphere of atomic energy.

In his speech at the inauguration of the Essen center, Undersecretary Professor Brandt of Düsseldorf suggested that chairs for nuclear research be established at German universities, for which, he said, a federal subsidy of about DM. 60 to 80 million would be needed. Brandt pointed out that the future role of German industry in the world market will largely depend on the progress of nuclear research in the Federal Republic.

Zoonoses

At least 89 infections of domestic and wild vertebrates represent threats to human health, according to a recent article by Meyer in the *Bulletin for Medical Research* [**10**, No. 1, 2 (Sept.–Oct. 1955)]. These zoonoses may invade the human body by way of the mouth, skin, mucous membranes, and respiratory tract. Transmission results most frequently from direct contact with diseased animals or contaminated animal products, but it may also occur through an intermediate vector.

The real problem of suppressing or eradicating these diseases lies in the discovery of their true reservoirs as well as in dealing with ineradicable mammalian or bird reservoirs. Some of the zoonoses represent major epidemiologic problems.

1) Bovine tuberculosis, which can produce both pulmonary and extrapulmonary tuberculosis in man, seems to be spreading to rural populations in Great Britain and Denmark.

2) The economically underdeveloped countries of Latin America and the Mediterranean area are the chief victims of brucellosis, which is acquired by man from cattle, goats, and sheep and causes extensive illness, misery, and economic loss.

3) Anthrax is an important disease in the eastern Mediterranean area and parts of Asia, Africa, and Latin America. It is acquired by man not only by contact with living or freshly killed animals, but also from their salvaged hides, hair, or wool.

4) No part of the world is free of rabies. Although the dog is the most important source of human infection, rabies in wild animals such as the fox, jackal, and wolf has reached epizootic proportions in both Europe and North America in recent years. The discovery in Mexico and South America that vampire bats act as symptomless transmitters has raised peculiar problems for rabies control in such areas.

5) Transmission of salmonellosis to man directly from animals and indirectly through food products presents a growing world-wide problem. Domestic fowls are large reservoirs, and cattle, dogs and cats can be symptomless excreters.

6) Until recently—with a few exceptions in Japan, Australia, Germany, and Italy—human leptospirosis has not been of great public health importance. Of late, however, it has been shown that this disease occurs more widely in domestic animals than had been believed formerly.

7) Q fever, which is chiefly acquired by man from goats, sheep, and cattle, is widespread; highly infected areas occur in many parts of Europe and in Turkey.

8) The chief reservoir of psittacosis in the United States is the parakeet, which causes about 40 to 50 clinical cases a year. Prevention of psittacosis is difficult because the disease is usually recognized only when it has reached epidemic proportions and also because quarantine regulations of imported psittacine birds are violated and reinfection is introduced by irresponsible trading and bartering. A similar viral agent, that of ornithosis, has been found in pigeons, ducks, turkeys and chickens.

Although the fact is often not appreciated, parasitic infections of other animals are quite as important as sources of human disease as those produced by bacteria and viruses. By way of illustration, three such parasitic diseases may be noted.

1) Hydatidosis, which is shared by man with sheep, cattle, and pigs, has an extensive geographical distribution but is prevalent only in countries where man, dog, and sheep—more rarely, cattle and pigs—are closely associated.

2) *Taenia saginata* occurs as an adult tapeworm only in human intestines; the larval stage develops in cattle tissues, causing "measly beef" more often than is usually realized. All populations eating raw or partly cooked beef are infected. The real problem of taeniasis is to keep cattle from contact with human feces.

3) Schistosomiasis can apparently be acquired by man from a variety of animals, but available data do not permit an evaluation of their relative importance. This disease is most prevalent in China, Formosa, the Philippines, the Celebes, and Japan.

Finally, it is pointed out that the cost of diseases of livestock and poultry in the United States alone in a single year was at least $1,316,620,000. The reduction of this great loss, with accompanying gain in health and food, should offer an attractive goal for a variety of interested groups.—W. L. S. Jr.

Research Associateship Program

Discussions by the personnel officer of the Naval Research Laboratory and his staff with representatives of the National Research Council and the Civil Service Commission have resulted in the establishment of a research associateship plan. Under the plan NRL prepares a series of specific research problems requiring research ability of a postdoctoral nature and falling within basic scientific and related areas in which the laboratory has need of assistance.

The National Research Council (i) prepares an announcement of these opportunities and distributes it to deans of colleges and universities; (ii) receives applications for the research opportunities and, after screening, establishes a list of eligible applicants in an order of competency for the individual research problem; (iii) provides supporting files for each eligible and a statistical summary of the distribution of applicants by scientific disciplines. NRL selects eligibles, in order of rank as determined by the NRC, to carry out the individual research problems, provided that the person also meets minimum Civil Serv-

ice requirements and security standards.

Under the research associateship program, each applicant must possess a Ph.D. in one of the physical sciences or in a related field, or he must have completed all of the academic requirements for the Ph.D. and be scheduled to receive the degree at the next commencement exercise of his academic institution.

The program further provides that each associate be appointed by NRL to the grade of GS-11 (base pay, $5940 per annum), the normal entrance grade in the Federal Civil Service system for an applicant having a Ph.D. degree in the physical sciences but who does not have additional professional experience. The length of an appointment is 1 year. Further information may be obtained by communicating with Dr. W. G. Torpey, Personnel Officer, Naval Research Laboratory, Washington 25, D.C.

New Synthetic Hormone

■ A new synthetic hormone, said to be three times as potent as aldosterone, is announced in the 20 Dec. 1955 issue of the *Journal of the American Chemical Society*. An article by John A. Hogg, Frank H. Lincoln, Robert W. Jackson, and William P. Schneider, all of the Upjohn Company, Kalamazoo, Mich., indicates that the new chemical is more effective in laboratory tests than any other known substance in stimulating the body's retention of salt, an ability that is characteristic of some adrenal cortical hormones.

Not produced in the body, the new synthetic hormone is described as a methyl derivative of fluorohydrocortisone acetate. It has no known usefulness in human therapy at present.

The new substance is about 40 times as powerful as hydrocortisone in its ability to influence glycogen deposition, another indication of hormonal activity. A second methyl hormone was also reported in the same article. This substance, named 2-methylhydrocortisone acetate, is ten times as active as hydrocortisone in the glycogen deposition assay.

New Medical Center at Brookhaven National Laboratory

The Atomic Energy Commission has announced that a medical research center, including a nuclear reactor designed specifically for medical research and treatment, will be constructed at Brookhaven National Laboratory. Brookhaven, one of the AEC's major research laboratories, is operated by Associated Universities, Inc.

Scheduled for completion in 2 years at a cost of $6 million exclusive of design and engineering, the new facility will house a nuclear reactor, a research hospital, an industrial medicine branch, and research divisions in medical physics, pathology, microbiology, biochemistry, physiology and clinical chemistry.

The present medical facility at Brookhaven consists of some 20 temporary buildings that were part of Camp Upton Hospital when the site was used by the Army during World War II. As the medical program has grown, the buildings have become inadequate as well as difficult and costly to staff and maintain.

The medical reactor at Brookhaven will be one of the first two in the United States. In July the AEC announced that the University of California had filed license applications with the commission for construction and operation of a medical reactor on the campus of the University of California at Los Angeles.

Medical research and treatment with neutrons have been conducted at Brookhaven since 1951 by utilizing the general-purpose research reactor already in operation there. Treatment of patients at this reactor, however, requires that other work cease during the medical run, interrupting the research programs of other laboratory departments. The new reactor, designed specifically for medical utilization, will make available a source of neutrons for experimental work on brain cancer, as well as a number of special short-lived radioisotopes, permitting a much wider range of medical investigation than is now under way.

Design specifications for the medical reactor are now being completed by Brookhaven scientists and engineers. When they are completed, proposals will be sought from firms in the equipment manufacturing field for fabrication of the reactor and its associated control equipment.

Reading Science Writing

A pilot study of how the public reacts to science news has recently been completed and a detailed report is being prepared. The study was carried out by the Survey Research Center of the University of Michigan among 200 people of varying backgrounds, social characteristics, and experiences. It was sponsored by the National Association of Science Writers and New York University with the aid of a grant from the Rockefeller Foundation. More than half of the interviews were taken in metropolitan Chicago and the rest in two rural counties in upstate New York—Onondaga and Cortland.

One of the chief purposes of the pilot study was to determine whether or not a larger survey would be worthwhile; both SRC and NASW now believe that it would. Some of the findings of the test survey follow:

More than three-quarters of the 200 persons interviewed read science news in their local papers. One-third of the sampling had attended college, far more than would be found in a typical U.S. cross-section.

One in four of those interviewed said they read all the science items that were published in their papers.

More than a third of the 200 persons interviewed wanted more science news. This point was further developed when they were asked to name what types of news they were willing to omit to make room for more science reporting. Some mentioned cutting down on sports news; others said society news. A sizable proportion of even those listed as occasional science news readers wanted some expansion in coverage, thus indicating what SRC calls "a potential for growth of the science audience at all levels of readership."

More than half of those interviewed were satisfied with the presentation of science news. Those who were dissatisfied complained of inaccuracies, sensationalism, insufficient details, too-technical language, and so forth. (These same points were mentioned by scientists who answered an earlier NASW-New York University questionnaire several years ago.)

All but three of the 200 interviewed had heard of the Salk vaccine. This represented close to saturation coverage. The pilot study found that the atomic bomb was the most common area for nonmedical science reading.

More than nine out of ten respondents had definite impressions of scientists, and the characteristics mentioned most frequently were superior intellect, dedication to work, and absent-mindedness.

Education, especially some high-school or college study in a field of science, was "positively related" to the desire to read more science news items. Apparently the avid science reader with intellectual preferences is the one who is most likely to want more science news.

Scientists in the News

OSCAR MARZKE, associate director of research for materials at the Naval Research Laboratory, Washington, D.C., has been appointed director of research at NRL. He succeeds EDWARD O. HULBURT, who is retiring from Civil Service and who has been named senior scientist for the U.S. National Committee for the International Geophysical Year.

PETER KING, superintendent of the

chemistry division, succeeds Marzke as associate director of research for materials, and WILLIAM A. ZISMAN, head of the surface chemistry branch, is the new superintendent of the chemistry division.

HARRY WEXLER, director of meteorological research at the U.S. Weather Bureau, has been appointed chief scientist for the U.S. Antarctic program of the International Geophysical Year, and ALBERT P. CRARY, a research scientist in geophysics for the Air Force Cambridge Research Center, has been appointed chief scientist of the U.S. Antarctic Glaciology program and deputy chief scientist of the over-all U.S. IGY Antarctic program.

Wexler will be responsible for carrying out the scientific program of geophysical research to be undertaken by American scientists on Antarctica during 1957 and 1958. The studies will be made at five U.S. bases, on a series of over-snow traverses, and from ships and aircraft.

Wexler is a pioneer in the study of the upper atmosphere, cold waves, and hurricanes. In 1944 he made the first penetration of an Atlantic hurricane by aircraft, for which he received the Air Medal. During the last war he served in the Air Force, where he initiated a program of research in weather that later developed into the large Air Force program in geophysics. Before the war he was professor of meteorology at the University of Chicago.

Crary will have charge of studies of seismology and gravity as well as glaciology and will supervise the scientific aspects of the over-snow traverses that will be conducted by the expeditions during 1957 and 1958. Until his departure for Antarctica in October 1956, he will engage in preparatory work for the expedition in Washington, D.C. He will remain in Antarctica for the entire IGY period, returning to the U.S. when antarctic stations are closed in January 1959.

Crary has spent most of the past 4 years in the Arctic, where he has specialized in investigations of arctic geophysics. In early 1952 he helped establish the first weather station base on T-3, an ice island that was then floating only 70 miles from the North Pole. During 1952, and again on his return to T-3 in 1953 and 1955, he made seismological and oceanographic observations and studies of sea and island ice. He conducted similar investigations on Ellesmere Island during a joint Canadian–U.S. expedition in 1954.

LOUIS N. RIDENOUR has been appointed director of the research laboratories of the missile systems division of Lockheed Aircraft Corporation. For the past year he has been serving as program development director for the division.

Ridenour, who was the first U.S. Air Force Chief Scientist, is perhaps best known for his service as chairman of the USAF Scientific Advisory Board Committee that surveyed Air Force research and development activities. The resulting "Ridenour Report" led to establishment of the office of Deputy Chief of Staff, Development, and also the Air Research and Development Command.

DUDLEY THOMPSON, associate professor of chemical engineering at Virginia Polytechnic Institute, resigned that position on 1 Jan. to accept a post as head of the chemical engineering department of the Missouri School of Mines.

GEORGE SARTON, professor emeritus of the history of science at Harvard University, is the first recipient of the Sarton medal, which is awarded for contributions to science history. The medal, named in Sarton's honor, is administered by the History of Science Society and was presented to Sarton on 29 Dec. during the society's annual meeting in Washington, D.C. The award of the medal was made possible by a grant of $1500 from Chas. Pfizer and Company, Inc., Brooklyn, N.Y.

Sarton, author of the five-volume *Introduction to the History of Science*, was a member of the Harvard faculty for 35 years. He was the founder and for 40 years the editor of the History of Science Society's journal, *Isis*.

LOWELL T. COGGESHALL, dean of the division of biological sciences at the University of Chicago, has been named by President Eisenhower to serve as special assistant for health in the Department of Health, Education, and Welfare. Coggeshall succeeds Chester S. Keefer of Boston, who vacated the post last July.

ARNE TISELIUS, director of the Institute of Biochemistry at the University of Uppsala, Stockholm, Sweden, received the Franklin medal on 18 Jan. for "outstanding investigations in biochemistry, valuable contributions to the knowledge of proteins and revolutionary new techniques for use in the field of protein chemistry." The award was made by the Franklin Institute of the State of Pennsylvania in a ceremony commemorating the 250th anniversary of the birth of Benjamin Franklin. Tiselius' most outstanding work is the development of electrophoretic and adsorption methods for the separation and analysis of proteins, enzymes, and other substances of biological importance.

ROBERT B. DODD, head of the department of anesthesiology at the University of Maryland School of Medicine, recently was named the Henry E. Mallinckrodt professor of anesthesiology at the Washington University School of Medicine (St. Louis). Dodd is the first named to the Mallinckrodt professorship, which was recently endowed by Edward Mallinckrodt, Jr., in memory of his son. Dodd also will be in charge of the division of anesthesiology in the department of surgery at the medical school. The appointment is effective in February.

DWIGHT E. GRAY, former chief of the technical information division at the Library of Congress, has been appointed program director for Government Research Information in the Office of Scientific Information of the National Science Foundation. He is the author of a textbook in the physical sciences, coauthor of a book on radiation monitoring, and is coordinating editor of the *American Institute of Physics Handbook*, which is now in preparation. He also serves on the editorial boards of two of the institute's journals.

R. EUSTACE SEMMES, pioneer in neurosurgery and member of the staff of the University of Tennessee College of Medicine since 1912, retired from his administrative duties at the college on 31 Dec. He remains professor of neurosurgery. Last fall colleagues of Semmes honored him with a presentation of his portrait to the university.

Semmes received a B.A. degree from the University of Missouri and, in 1910, an M.D. degree from Johns Hopkins University. He first joined the University of Tennessee as an assistant; since 1932 he has been professor.

A fellow of the American College of Surgeons, Semmes was recently named an honorary member of the American Academy of Neurological Surgery. He was one of the group of founders of the American Board of Surgery, the American Board of Neurological Surgery, and the Harvey Cushing Society.

MORTON I. GROSSMAN, formerly chief of the physiology division, Medical Nutrition Laboratory, Denver, Colo., has become chief of the section on gastroenterology at Wadsworth General Hospital, Veterans Administration, and associate clinical professor of medicine in the University of California Medical Center, Los Angeles.

A. DONALD RANKIN, head of the department of physiology in the School of Veterinary Medicine, Colorado A. and M. College, has been appointed associate medical director in charge of vet-

erinary products at the Squibb Institute for Medical Research, New Brunswick, N.J. He is succeeded at Colorado A. and M. by N. H. BOOTH of the department of physiology.

PETER A. VAN DER MEULEN, director of the Rutgers University School of Chemistry, has been named acting head of the university's new center for training and research in nuclear science.

In its proposed budget for 1956–57, the university has asked the state of New Jersey to provide $112,310 for the initial equipment and staff salaries for the center. Pending state action on this request, Rutgers will proceed with the organization of the Nuclear Science Center within the limits of its own resources.

Certificates of appreciation for outstanding service in connection with the participation of the United States delegation in the International Conference on the Peaceful Uses of Atomic Energy in Geneva, Switzerland, 8–20 Aug. 1955, have been awarded by the Atomic Energy Commission to four members of the professional staff of the delegation. The recipients of the awards, and the outstanding services for which they were cited are as follows:

HARRY S. TRAYNOR, executive officer. Traynor is assistant general manager of the AEC. His citation states that he "successfully handled the many difficult organizational and administrative arrangements that were so fundamental to the success of the participation of the U.S. in the Conference."

JOHN P. McKNIGHT, information officer. McKnight, now public affairs officer at the U.S. Embassy in Korea, was loaned to the delegation by the U.S. Information Agency. His citation notes that he "directed the overseas dissemination of information related to United States participation in the conference."

GEORGE L. WEIL, technical director. Weil is a private consultant on atomic energy who joined the staff of the AEC for the preconference preparations. His citation states that he "organized the technical phases of the United States program and was largely responsible for its successful presentation at the Conference."

PAUL W. McDANIEL, technical papers officer. McDaniel is deputy director of the commission's Division of Research. His citation states, "in his role as Technical Papers Officer and as adviser to the scientific delegates from the United States, he contributed substantially to the excellent presentation of the United States program."

IRVING ROTHCHILD has joined the department of obstetrics and gynecology at Western Reserve University as staff endocrinologist with the rank of associate professor.

MERVIN J. KELLY, president of Bell Telephone Laboratories, Inc., has been elected a foreign member of the Swedish Royal Academy of Sciences.

In a letter notifying Kelly of the honor, the secretary of the academy said: "Our Society is most happy in conferring on you this token of profound respect, called forth by your masterly researches in the domain of Electronics and Electrotechnics, which have forever enrolled your name in the Annals of these Sciences."

DAVID S. ANTHONY, who formerly directed the biology division of Mound Laboratory, has joined the University of Florida as associate professor of chemistry.

F. EARLE LYMAN, former associate professor of zoology at Southern Illinois University, has joined the staff of the Division of Research Grants, National Institutes of Health, as executive secretary of the morphology and genetics study section.

JOHN B. PAGE has been named professor and head of the department of agriculture at the A. and M. College of Texas.

ISAO IMAI, professor of physics at the University of Tokyo, is serving as visiting professor at the University of Maryland, where he is conducting seminars on approximation methods in fluid dynamics in the university's Institute of Fluid Dynamics.

The following appointments to assistant professor have been announced. University of Chicago: PHILIP M. MARGOLIS, psychiatry. University of Texas: GORDON C. MILLS, biochemistry and nutrition. Stevens Institute of Technology: FRANCIS B. CLOUGH, chemistry. University of Utah: BURL E. BRYANT, chemistry. New Mexico College of Agriculture and Mechanic Arts: D. C. REAMS, JR., chemical engineering.

Recent Deaths

JOHN W. BARNARD, Milwaukee, Wis.; 43; professor of anatomy at Marquette University School of Medicine; 24 Dec.

VILRAY P. BLAIR, St. Louis, Mo.; 84; professor emeritus of clinical surgery at Washington University School of Medicine (St. Louis); World War I chief plastic surgeon for the American Expeditionary Forces in Europe; 24 Nov.

WALTER D. BONNER, New Haven, Conn.; 78; professor emeritus of chemistry and former chairman of the department at the University of Utah; 3 Jan.

DONALD R. CHARLES, Rochester, N. Y.; 46; geneticist and past professor of zoology and chairman of the department of biology at the University of Rochester; 24 Nov.

LOUIS COHEN, Hamden, Conn.; 49; former associate clinical professor of psychiatry at Yale University; specialist in legal psychiatry; 30 Dec.

LUDWIG DUERR, Friedrichshafen, Germany; 78; expert on construction of dirigibles; 1 Jan.

FRANCIS E. FRONCZAK, Buffalo, N.Y.; 81; internationally known public health officer; United States medical adviser and relief administrator in Poland in the post-World War I period; 27 Dec.

MORRIS GROSSMAN, Jersey City, N.J.; 74; physician and neuropsychiatrist; formerly a neurologist at the College of Physicians and Surgeons, Columbia University; 28 Dec.

GEORGE HELLER, New York, N.Y.; 49; microbiologist and immunologist; research associate at the Hospital for Special Surgery, New York; World War II chief of the division of bacteriology of the First Medical General Laboratory, European Theater; 28 Dec.

JOSEPH HORY, New York, N.Y.; 63; eye specialist; director of eye services at Morrisania Hospital, New York; 1 Jan.

FRANK N. KNEAS, Philadelphia, Pa.; 80; structural engineer; 25 Dec.

JOHN C. MINOR, New Caanan, Conn.; 82; retired chemical engineer; World War II member of the War Production Board; 27 Dec.

LUDGER MINTROP, Heidelberg, Germany; 75; geologist and developer of seismographic instruments for determining the kind and depth of layers of the earth; 2 Jan.

RAYMOND L. MITCHELL, Madison, Wis.; 49; research chemist at the U.S. Forest Products Laboratory, Madison; 23 Dec.

JOHN P. PETERS, New Haven, Conn.; 68; senior professor of medicine at Yale University; leader in the movement for the improvement of medical care and for the expansion of public health services; 29 Dec.

FRANCIS PYNE, Elizabeth, N.J.; 72; retired engineer; former superintendent of the Anaconda Copper Company, Perth Amboy, N.J.; World War II member of the copper section of the War Production Board; 28 Dec.

SALVATORE M. SANTELLI, Brookyln, N.Y.; 34; assistant professor of pharmacy at Brooklyn College of Pharmacy, Long Island University; 21 Dec.

THOMAS A. SHALLOW, Philadelphia, Pa.; 69; Samuel D. Gross professor

of surgery and head of the department at Jefferson Medical College; 27 Dec.

MARTIN SINGER, East Meadow, N.Y.; 42; associate professor of psychology at Adelphi College; 21 Dec.

ERNEST G. THEROUX, Brooklyn, N.Y.; 72; retired chairman of the department of physics at St. John's College (Brooklyn); 26 Dec.

Education

■ Establishment of a School for Advanced Study at Massachusetts Institute of Technology was announced on 4 Jan. The new school will provide means by which postdoctoral scholars from all over the world can join with the M.I.T. faculty in theoretical studies and research. Martin J. Buerger, professor of mineralogy and crystallography, has been appointed director.

The new school will formalize opportunities for advanced study that are already available at M.I.T. Initially the unit will be simply an organizational entity, but ultimately it is hoped to provide a center and adequate housing for fellows and guests.

Scholars who are invited to M.I.T. for advanced study will have the status of fellows in the School for Advanced Study. During this academic year there have been approximately 100 such people from 15 countries studying at the institute and they have been registered either as guests or as visiting fellows. By establishing a school, the institute will be able to bring the scholars closer together and closer to members of the faculty. Special programs can be organized and arrangements can be made for the visitors to meet in informal conferences.

The school will be similar in its objectives to the Institute for Advanced Studies at Princeton, but the Princeton center has a permanent staff of some size. Unlike the Princeton school, the M.I.T. School for Advanced Study will be an integral part of the institute and will constitute an extension of the level of the programs of the undergraduate and graduate schools.

Professors participating in the activities of the advanced study division will remain on the faculties of the five present schools—those of science, engineering, architecture and planning, industrial management, and humanities and social studies. Initially, the special staff of the school for Advanced Study will consist only of the director and a secretary. Buerger will assume the office of director on 1 July.

■ The American Society for Metals is sponsoring a nationwide science achievement award program in which junior and senior high-school students will compete for U.S. Savings Bonds. The contest is to be divided into eight geographical regions. There will be 40 winners in three grade classifications in each region and 20 special national awards to students whose entries deal with metals and metallurgy. Entries or projects may be on any subject of science and mathematics.

The program is underwritten by a grant of $10,000 from ASM; the cost of the program's operations is also covered by ASM. Administration of the contest and awards will be carried out by the National Science Teachers Association, Washington, D.C., through its Future Scientists of America Division.

■ The National Heart Institute of the U.S. Public Health Service is conducting a research training program in enzyme chemistry at the Institute for Enzyme Research of the University of Wisconsin under the direction of D. E. Green. Candidates must possess a Ph.D. or M.D. degree. Stipends conform to those in effect for postdoctorate research fellows of the Public Health Service. Application forms and further information may be obtained from the Institute for Enzyme Research in Madison.

■ The department of zoology, Duke University, has announced that a course in radiation biology for seniors and graduates will be offered in the second semester, which begins on 1 Feb. The course will stress the fundamental physical, chemical, and biological principles underlying the biological actions of radiation, and will include a general survey of the more important biological effects of ionizing and ultraviolet radiation. The course will be organized and taught by J. S. Kirby-Smith, biophysicist and visiting professor at Duke University on leave from the biology division of Oak Ridge National Laboratory.

■ The Oak Ridge Institute of Nuclear Studies has announced a partial schedule of 4-week courses in radioisotope techniques to be offered this year. The first of the basic courses, which are offered by the special training division, began 9 Jan.; others are scheduled to begin 6 Feb., 16 Apr., 14 May, 6 Aug., and 3 Sept.

The ORINS special training division, in cooperation with the medical division, also will hold special advanced courses in the use of radioisotopes in hematological studies and procedures, 14–18 May, and in general medical research and procedures, 21–25 May. These two advanced courses are designed for medical personnel who have had previous experience in the use of radioisotopes.

In addition, during 1956 ORINS will conduct four courses in veterinary radiological health for veterinary officers of the Armed Forces. Starting dates for these 2-week courses are 27 Feb., 12 Mar., 3 Apr., and 4 June.

Dates for additional courses will be announced as they are scheduled. Further information may be obtained by writing the Special Training Division, Oak Ridge Institute of Nuclear Studies, Box 117, Oak Ridge, Tenn.

■ Columbia University has announced a new program of night studies in industrial and management engineering. All who are able to pass qualifying tests will be accepted in the new program.

A pilot study, with a limited group of special students, has been in progress since the fall of 1954. This experimental evening work demonstrated that the program should be made available to all interested students.

Under the new arrangement, which goes into effect in February with the opening of the spring session, persons having no college background, or those who have had some college work but lack engineering credits, may study toward the B.S. degree at the School of General Studies during the later hours of the day. Their courses will be identical to those offered in the full-time preengineering program and will be taught by the same faculty.

■ The University of California's newest College of Letters and Science in Riverside now has a staff of 11 in its division of life sciences. The division is headed by Herman T. Spieth, professor of zoology, and for 20 years a member of the faculty of City College of New York.

■ A tuition-aid policy directed toward promoting the teaching of science and mathematics in secondary schools will by inaugurated in the University of Pennsylvania's 1956 Summer School. The Summer School will offer twice as large a volume of tuition grants as was offered in 1955 to school teachers and administrators who took graduate studies in the arts and sciences generally. In allocating this aid, preference will be given to those choosing courses in the physical and biological sciences and in mathematics. Such applicants will be eligible for twice as much aid as those taking courses in other fields.

The grants will be made mainly to school teachers in the Philadelphia area. Candidates are to be nominated by their principals or superintendents.

Grants, Fellowships, and Awards

■ The Institute of Personality Assessment and Research, which is under the direction of Donald W. MacKinnon of the University of California, Berkeley, has

received a grant of $150,000 from the Carnegie Corporation of New York for a study of creativity to be conducted over the next 5½ years. It is proposed, under the grant, to consider three aspects of creativity: (i) the traits of personality and temperament that are correlated with high-level creativity of thought and action; (ii) the intrinsic psychological nature of creative acts and creative thinking; and (iii) the determination of the characteristics of the life situation, the educational experiences, and the social and cultural conditions that tend to facilitate or inhibit the appearance of creativity. Members of the institute's staff who will participate in this research are Frank Barron, Jack Block, Richard S. Crutchfield, Harrison G. Gough, Robert E. Harris, and Donald W. MacKinnon.

■ The Division of Biological and Medical Sciences of the National Science Foundation has announced that the next closing date for receipt of research proposals in the life sciences will be *1 Feb.*

■ The Mycological Society of America has announced the availability of a graduate fellowship in mycology. The fellowship carries a stipend of $750.

Eligible candidates must be predoctoral students in residence at the institution where they are registered for the Ph.D. degree. A fellow may hold additional appointments, not to exceed half-time. Forms for application may be obtained from the secretary-treasurer of the society, Dr. C. J. Alexopoulos, Department of Botany and Plant Pathology, Michigan State University, East Lansing, Mich. Applications are due *by 15 Feb.*

■ The General Foods Fund, Inc., an independent foundation sponsored by General Foods Corporation, has announced an aid-to-education program for 1956, with grants totaling $278,000. The program is broader in scope than the Fund's first aid-to-education program that was announced in 1954. Three colleges, Amherst, Hamilton, and Oberlin, have been selected to receive grants of $25,000 each. Grants totaling $117,500 are being made to 16 state and regional associations of private liberal arts colleges. Grants are also being made to three foundations: $25,000 to the National Fund for Medical Education, $20,000 to the United Negro College Fund, and $2500 to the Future Scientists of America Foundation of the National Science Teachers Association. These grants, totaling $240,000, will provide unrestricted operating funds for 360 participating institutions.

Five 4-year scholarships in the physical sciences to be administered by the National Merit Scholarship Corporation and two graduate-study fellowships in food technology to be administered by the Institute of Food Technologists complete the program.

■ Graduate opportunities in botany at Columbia University for 1956–57 are as follows:

Research assistantships

Biochemistry: industrial fellowship in plant products and their biochemistry. R. F. Dawson.

Cellular morphology and growth: research assistantship in cellular and experimental morphology, growth, and development, in plants and animals. E. B. Matzke.

Cytogenetics and cell physiology: AEC grant in nucleic acid and nucleoprotein metabolism in cells, using radioisotopes and autoradiographs. Stipend, approximately $2000. J. H. Taylor.

Mycology: research assistantship in cytology, genetics, or sexuality of fungi. L. S. Olive.

Physiology: research assistantship in mineral nutrition. S. F. Trelease.

Higgins and University fellowships

Any field of botany: stipend, $1500 to $2000. Applications are *due 20 Feb.* Forms may be obtained from the Office of Admissions, 322 University Hall, Columbia University, New York 27.

Teaching assistantships (stipends, $1300 with free tuition)

General botany (Columbia College): E. B. Matzke.

General botany (Barnard College): D. D. Ritchie.

Microbiology (Barnard College): Helen B. Funk.

Morphology and cellular morphology: E. B. Matzke.

Mycology: L. S. Olive.

Biochemistry of fungi or higher plants: R. F. Dawson.

Physiology: S. F. Trelease.

Inquiries for further information or for application forms (except for Higgins and University fellowships) should be addressed to the professor concerned at the Department of Botany, Columbia University, New York 27. Fellowships and assistantships for Columbia University are also available at the New York Botanical Garden and at the Boyce Thompson Institute for Plant Research.

■ The Albert and Mary Lasker Foundation has announced the seventh annual Albert Lasker medical journalism awards competition. All newspapermen and magazine writers who have written medical or health articles during 1955 are eligible. The deadline for entries is *27 Jan.*

Inaugurated in 1949, the medical journalism awards consist of $1000 each, a citation, and a silver statuette of the Winged Victory of Samothrace, symbolizing victory over death and disease. They will be presented to the newspaper writer and the magazine writer who have written the year's best articles, series of articles, editorials, or columns dealing with the improvement of public health or the prolongation of life through medical research or public health programs.

In addition to the newspaper and magazine categories, the judging committee will consider noteworthy medical journalism contributions in other mass media during 1955, including radio and television.

Entries may be made by individual writers, by editors, or by readers of newspapers and magazines. As many entries as desired may be submitted, provided that articles have been published in a newspaper or magazine dated during the calendar year 1955. Entries should be forwarded to the Nieman Foundation for Journalism, 44 Holyoke House, Cambridge 38, Mass. Entry blanks and other information may be obtained from the Nieman Foundation.

■ The Harvard University School of Public Health has announced that public health scholarships for 1956–57 will be granted to individuals of high professional promise in awards ranging from part tuition to tuition plus a stipend, depending on the qualifications and financial needs of the applicants. The scholarship funds are limited and are intended primarily for citizens of the United States. In general, preference will be given to applicants under 35 years of age.

A scholarship applicant must be eligible for admission to the school as a candidate for one of the following degrees: master of public health, doctor of public health, master of science in hygiene, doctor of science in hygiene, or master of individual health.

A catalog of the school, admission and scholarship applications, and further information may be obtained by writing to the Secretary, Harvard School of Public Health, 55 Shattuck St., Boston 15, Mass. Completed admission and scholarship applications must be submitted *by 1 Mar.*

■ Award of 44 unclassified life-science research contracts in the fields of biology, medicine, biophysics, and radiation instrumentation has been announced by the Atomic Energy Commission. Seven of the awards, each of which is for 1 year, are new projects. Three are in biology and four are in the medical sciences. Thirty-seven contract renewals for 1 year were awarded to allow for continuation of research already in progress. Eighteen of these are in biology, fourteen in medicine, three in biophysics, and two in radiation instrumentation.

Reports and Letters

Chemical Model of Drug Action

Orienting experiments were performed to test a working hypothesis on the mode of action of some drugs. The hypothesis is based on the observation that a striking number of drugs that display a great variety of effects contain certain functional groups at the same distance of about 5½ A from each other (*1*) as the distance between two turns of the α-protein helix (*2*). The fact that these functional groups (hydroxyl and amine) are capable of hydrogen bonding suggests that the molecules of such drugs might be able to attach themselves by hydrogen bonds to proteins, thus changing the native hydrogen bonding arrangement and the shape of the protein molecules. If the protein is an enzyme, and if the change is great enough and occurs at a sufficiently critical point of the enzyme molecule, an alteration of its specificity may result. Drug action could be the consequence of such alteration in an enzyme.

Should this picture correspond to reality, the hydrogen bonding of properly spaced functional groups would account for the (nonspecific) ability of drugs that possess these functional groups to attach themselves to proteins. Other structural features—benzene rings, alkyl chains, acyl groups, and so forth—must then be held responsible for the specific action of each drug by preferentially adhering to one or the other particular enzyme in a way that essentially changes the shape of the enzyme molecule. Further hydrogen bonding, electrostatic interactions, appropriate spatial fit of the two molecules, and other factors may play a role in this specific drug-enzyme interaction.

The difficulty of seeing clearly in the interaction of complicated drug molecules with complex proteins prompted us to reduce the experimental situation to its bare essentials. Our first orienting experiments were therefore designed to provide information on whether a simple molecule that possesses only the requisite two functional groups at 5½-A distance and thus serves as a model for all drugs with such functional groups is able to associate with amino acids and simple peptides by hydrogen bonding. To this end, the drug model was brought to equilibrium between water and a lipophilic solvent, and it was determined whether, other things being equal, the presence of an amino acid or peptide in the aqueous layer shifts the distribution of the drug model in the direction of water.

As a lipophilic solvent, we used chloroform. As the drug model, we selected diethylaminoethanol (DEAE) for the following reasons: (i) it is easily available in high purity; (ii) it has the desirable water-to-chloroform distribution ratio of about 1 to 2, and (iii) since it is a base, it is readily estimated by titration. (Our method was *p*H titration.) The conditions of the experiment were fixed in such a way that 100 mg of amino acid or peptide were added to 10 ml of water, the *p*H of the resulting solution was measured, 10 ml of chloroform and 50 mg of DEAE were added and stirred to equilibrium, the chloroform layer was extracted with excess standard HCl, and the amount of DEAE in it was determined by back-titrating the excess. We worked on the chloroform layer because the insolubility of amino acids and peptides in it provides a simpler situation than that provided by the aqueous layer, which contains amino acid or peptide in addition to DEAE. In order to eliminate *p*H effects, the experiment was repeated without amino acid or peptide, using a buffer solution of the same *p*H as was measured originally for the amino acid solution; the distribution of DEAE between water and chloroform obtained at this *p*H was taken as the blank with which its distribution in the presence of amino acid or peptide was compared.

Each experiment was performed 12 times, and the average of the results was taken; the maximum deviations of individual values from the average were generally 8 percent either way.

It was found that, under the conditions established for these experiments, the following figures represent the mole-percent of each amino acid and peptide that is bound to DEAE: glycine, 1; alanine, 1; glycyl alanine, 40; glycyl glycyl glycine, 50; alanyl glycyl glycine, 55; leucyl glycyl glycine, 61. Since the comparison with the blank excludes *p*H effects, we believe that these figures do indeed show the effect of hydrogen bonding between DEAE and the various amino acids and peptides used. Whether our findings can be generalized to other amino acids, peptides, and proteins on the one hand, and to actual drugs on the other hand, and whether any definite stoichiometric relationships exist in this binding is the subject of further research now in progress that will be reported from time to time.

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References and Notes

1. C. C. Pfeiffer, *Science* 107, 94 (1948).
2. L. C. Pauling and R. B. Corey, *Proc. Natl. Acad. Sci. U.S.* 37, 204 (1951).
3. This investigation was supported by a grant from the John J. Pender Cancer Fund.

8 August 1955

Intracellular Recording from Moving Tissues with a Flexibly Mounted Ultramicroelectrode

Intracellular recording with Graham-Ling-Gerard microelectrodes (*1*) (tip diameter less than 0.5 microns) has proved useful for studying the electric activity of excitable tissues. However, muscle studies have been hampered because the movement that accompanies activity often dislodges the electrode, damaging the cell and occasionally breaking the electrode. This problem is particularly acute in cardiac muscle. Heretofore, the attempt has been to immobilize the tissue with respect to a rigidly mounted electrode (*2*, *3*). This report describes a technique for flexibly mounting an ultramicroelectrode (UME) so that it moves easily with an unrestrained tissue without being dislodged (*4*). When this mounting is used, recordings of intracellular activity that were previously difficult or impossible to obtain can be made routinely. For example, consistent recordings can be obtained from a heart moving as much as 2 cm.

A piece of 1 mil (0.001 in.) bare tungsten wire several inches long is pushed into the large end of a microelectrode until the wire end jams in the tapering region of the electrode. This force fit is tight enough to hold the electrode tip on the wire after the portion of the UME that is larger than the wire has been broken off. The break is made by holding the tapered region firmly with the thumb and forefinger of each hand and gently bending the electrode until it breaks. If excessive force is applied, the tip may also snap off. The necessary force is usually not excessive if the break is made near the jammed end of the wire. The

large end of the electrode is then slipped over the free end of the wire. The electrode assembly now consists of a few inches of tungsten wire tipped by the terminal centimeter of an ultramicroelectrode. The length of wire used depends on the excursion of the tissue in which it will be used. If movement is slight, a short straight piece is used; if movement is large, a longer piece (3 to 4 in.), with a right-angle bend near its midpoint, is more satisfactory. The wire is fastened to the micromanipulator and the input grid so that the UME tip is approximately vertical.

For intracellular recording, the electrode is lowered onto the heart with the micromanipulator. As the electrode is advanced, it penetrates easily at first and then with increasing difficulty as it wedges into the tissue. An equilibrium position is quickly reached that is likely to be inside a cell. It may be necessary to adjust the tension slightly from time to time to keep the electrode well sealed into the cell.

Since the contact area between the tungsten wire and the KCl in the UME is small, the possibility that current during recording might polarize the interface was explored. A 100-mv signal produced no drift, but a 1-v signal did cause some drift. Experience has shown that polarization is not a problem if the input circuit is kept reasonably balanced.

This technique has been successfully used to record from the following tissues *in situ*: pacemaker region of frog, turtle, and rabbit; atrium and ventricle of frog, turtle, rat, guinea pig, rabbit, and monkey; ventricle of dog; striated muscle of frog; and uterus of pregnant guinea pig and rabbit. Attempts to record from the spinal cord and cortex in cat and monkey with electrodes mounted in this way have thus far been largely unsuccessful.

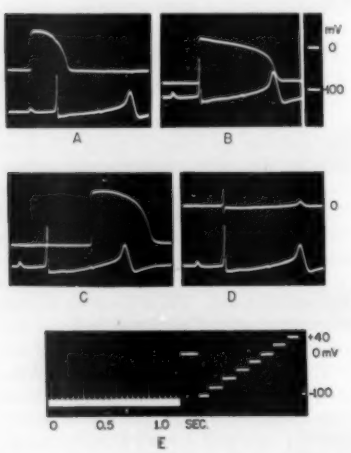

Fig. 1. Potentials from frog heart. Upper trace, intracellular record; lower trace, surface ECG. (*A*) Atrium; (*B*) ventricle; (*C*) truncus arteriosus; (*D*) same as *B* but with microelectrode just withdrawn from the cell; (*E*) time and voltage calibration.

Figure 1 shows typical records, photographed from a cathode-ray oscilloscope, of activity in frog atrium (*A*); ventricle (*B*), and truncus arteriosus (*C*). The upper trace is always the intracellular record and the lower trace the surface ECG, recorded near the atrioventricular border. Note the time coincidence between the depolarization phase of the atrial action potential and the P wave (*A*); between ventricular depolarization and the QRS complex, (*B*); between repolarization and the T wave (*B*); and between truncus depolarization and the small diphasic wave occurring just before the T wave (*C*). Record *E* shows the time and potential scales; *D* is discussed in a subsequent paragraph.

The records in Fig. 2 are from guinea pig heart; *A*, *B*, and *C* show records obtained from the same ventricular fiber 5, 20, and 35 minutes after impalement. The size and shape of the ventricular action potential changed little in 20 minutes, but it was considerably attenuated after 35 minutes. As in Fig. 1, the lower trace is the surface ECG. In Fig. 2, records *D* to *I* are from the atrium before and after a maximal 2-second tetanus of the right vagus nerve. The records shown were the action potentials of the 1st, 2nd, 3rd, 6th, 9th, and 18th beats after vagal stimulation. The duration of the potentials progressively increases, and the time between beats decreases as the effect of the vagal stimulation wears off.

These records resemble those of Hoffman and Suckling (*5*) but differ in that Hoffman and Suckling found no change in the height of the action potentials. The resting potential was apparently increased by vagal stimulation. The increase shown in *E* of Fig. 2 is electrode polarization produced by spread of the vagal stimulating current. Del Castillo and Katz (*6*) have, however, shown a vagally induced repolarization in frog pacemaker.

The intracellular records show interference by volume conducted activity from adjacent regions (*7*). This is especially true of ventricular activity, and little confidence can be placed in the shape of the rising phase of the ventricular action potential. Theoretically, the extent to which adjacent activity contributes to the potential recorded by an intracellular electrode should depend directly on the size of the heart, if other conditions are equal. Experiments on various animals have confirmed this. Record *D* in Fig. 1 shows the potential recorded when the electrode was withdrawn just outside the frog ventricular cell, the action potential of which is shown in *B*. This potential external to the cell is of considerable magnitude and distorts the rising phase and, to a lesser extent, the falling phase of the intracellular record. In the intracellular atrial records from guinea pig (Fig. 2*D*), a distinct dip coincides with the second dip on the ECG, which is the QRS complex. The dip is also seen in *G*, *H*, and *I*. The influence of the activity in adjacent regions on the intracellular recordings is exaggerated because the heart was in air rather than immersed in a volume conductor.

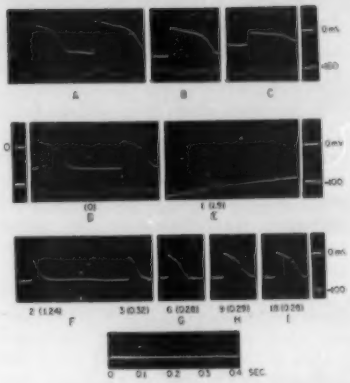

Fig. 2. Potentials from guinea pig heart. Traces same as Fig. 1. (*A*) Two ventricular beats 5 minutes after impalement; (*B*) one beat after 15 minutes; (*C*) one beat after 35 minutes; (*D*) atrium before stimulation of right vagus nerve; (*E–I*) successive stages in recovery from vagal stimulation. Figures below the records give the number of beats since vagal stimulation. Figures in parentheses give the time in seconds since the start of the previous action potential.

More accurate recordings of transmembrane potentials can be obtained by placing the indifferent electrode on the surface, closely adjacent to the intracellular electrode (*3*).

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5 August 1955

Inhibition of the Effect of Some Carcinogens by Their Partially Hydrogenated Derivatives

It has been observed in various fields of biochemistry that a biologically active compound—for example, a vitamin—may be prevented from displaying its effect in the presence of a closely related derivative (antivitamin). The latter probably plays the part of a competitor for intracellular receptors.

The basic idea of our work (*1*) was to investigate whether or not the simultaneous injection of a strong carcinogen and a close derivative that differs from the carinogen by the level of oxidation only would prevent the appearance of malignant tumors. Evidently these experiments had to be conducted under conditions that secured a high tumor incidence in the absence of the added compound.

For this purpose, some reduction products of 20-methylcholanthrene and of 1,2,5,6-dibenzanthracene were prepared by partial and by total catalytic hydrogenation (*2*) and subsequent chromatographic resolution. Thus, methylcholanthrene yielded the 6,7-dihydro and the 1,2,3,4,11,14-hexahydro derivatives that were described earlier by Fieser and Hershberg (*3*), as well as the fully hydrogenated perhydromethylcholanthrene. Starting from dibenzanthracene, a dihydro, a decahydro, and the perhydro derivatives were obtained; however, the structure of the two partially hydrogenated compounds cannot be established with certainty at the present time. The decahydro compound melts sharply at 176°C, while the dihydro derivative is possibly a mixture of isomers.

In each instance, 30 male C57 mice, 3 to 4 months old were treated (*4*). They were kept on a standard commercial chow diet supplemented with rolled barley and were given water *ad libitum*.

The subcutaneously injected ethyl laurate solution (single injection) contained 30 μg (1 part) of carcinogen (TD_{75}) and 15 parts of hydrogenated carcinogen. The experiments were allowed to continue for 12 months.

The results are summarized in Table 1; all tumors listed there were subcutaneous spindle cell sarcomas. Table 1 demonstrates that while the addition of the fully hydrogenated substances had no influence on the carcinogenic potency, some partially reduced derivatives were highly effective in decreasing the tumor incidence. Thus, in the methylcholanthrene series, the tumor yield was decreased from 28 percent to 8 percent. In the case of dibenzanthracene, the results were more striking since its partially hydrogenated derivatives completely inhibited the tumorigenic power of the parent compound.

The incidence data reported are in good accordance with some other features. Indeed, an association may be observed between the tumor yield, tumor induction period, intervals of subsequent tumor formation, and the chemical nature of the hydrogenates. Table 1 shows that the presence of hexahydromethylcholanthrene not only decreased the number of observed tumors from 8 to 2 but also lengthened the induction period from 21 to 31.5 weeks. Furthermore, the interval between the first and the second tumor was extended from 0 to 18 weeks.

Although the available data are not extensive enough for a broad generalization, it is clear that in the series of polycyclic carcinogens a strong inhibiting effect of partially reduced derivatives does exist and that it reaches its optimum at a certain hydrogenation level. The weak effect of dihydromethylcholanthrene may be understood on the basis of its slight structural difference from methylcholanthrene and hence by its possible *in vivo* conversion into the carcinogen. In contrast, the inertness of the two fully hydrogenated substances studied could well be explained by the circumstance that since they are void of aromatic character and are no longer close derivatives of the parent compound, they cannot act as anticarcinogens in the tissue.

Our results are in line with some related data, especially with the concept of competition between carcinogens and anticarcinogens for available intracellular receptors (*5*).

Table 1. Inhibition and retardation of the carcinogenic effect of 20-methylcholanthrene and of 1,2,5,6-dibenzanthracene by some hydrogenated derivatives.

Compound	No. of animals	Survivors at time of first tumor	No. of tumors	Sequence of tumor appearance (wk)
20-Methylcholanthrene (MC)	30	29	8	21, 21, 21, 22, 22.5, 27.5, 28.5, 34.5
6,7-Dihydromethylcholanthrene + MC	30	29	6	18, 18, 18.5, 19, 26, 50.5
1,2,3,4,11,14-Hexahydromethylcholanthrene + MC	30	30	2	31.5, 49.5
Perhydromethylcholanthrene + MC	30	30	7	14.5, 18, 27.5, 27.5, 28, 31.5, 33
1,2,5,6-Dibenzanthracene (DB)	30	29	7	19, 25.5, 27, 29, 32, 39, 43
Dihydrobenzanthracene + DB	30	30	0	none
Decahydrobenzanthracene + DB	30	29	0	none
Perhydrobenzanthracene + DB	30	30	5	27, 34, 40, 42, 44

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5 August 1955

Two Methods of Obtaining Least Squares Lines

S. I. Askovitz reported a method for determining the mean y value ($\bar{y}$) from graphic data (*1*). Two methods of obtaining the best fitting straight line through a set of points are presented here. The first method uses the Askovitz technique to find $\bar{y}$, while the slope is calculated from the values of y on a transposed x-axis. The second method is, to my knowledge, original and is completely graphic. In it, two points of the best fitting line are found directly on the graph. In each case, if the original data are in the form of a continuous curve, discrete values of x must be chosen, and the same limitation holds as in Askovitz' method, namely, that the individual points must be at equal intervals of x.

First method. A modification of the method of Arkin and Colton (*2*) is used —that is, when there are an odd number

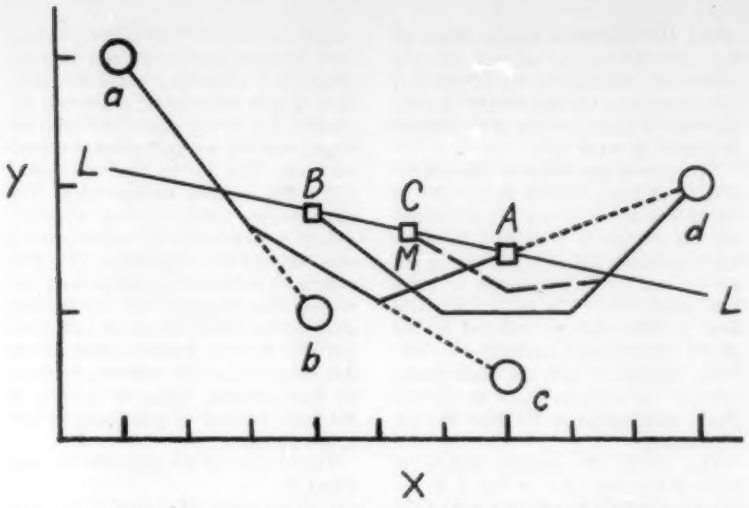

Fig. 1. The least squares line for the points *a*, *b*, *c*, and *d* is *LL*. The mean *y* value is at *C*. *A* is the balance point for the centroid weighted as $a=1$, $b=2$, $c=3$, and $d=4$. *B* is the balance point for the centroid weighted as $a=4$, $b=3$, $c=2$, and $d=1$. *M* is the midpoint of the line segment *AB*. The dotted and solid lines show the graphical way of determining *A* and *B*. The dashes show the graphical way of determing the check point *C*.

of points plotted, the origin of the abscissa is shifted to the middle point of the set. To the left of the origin, the points are numbered -1, -2, -3, and so forth, and to the right they are numbered $+1$, $+2$, $+3$, and so forth. If there are an even number of points, a point on the abscissa midway between the middle points is made the origin. To the left of this origin, the values are taken as -1, -3, -5, and so forth; to the right they are taken as positive odd integers.

The *y* value of each point is multiplied by its new corresponding *x* value. The sum of these products is divided by Σx^2. A table for the values of Σx^2 can be computed from Eq. 1 and Eq. 2. When *n* is odd

$$\Sigma x^2 = \frac{n(n^2-1)}{12} \qquad (1)$$

and when *n* is even,

$$\Sigma x^2 = \frac{n(n^2-1)}{6} \qquad (2)$$

where *n* is the number of points in the set and *x* is the transposed abscissa value of the point. The Σx^2 terms of Eq. 2 are already corrected for having been placed on a transposed axis and computed in units of $x/2$.

Second method. Referring to the uniform distance between points as a "unit," proceed as follows (Fig. 1). Align a straightedge with the first (*a*) and second (*b*) points of the data. Place the point of a pencil along the straightedge, two-thirds of a unit from *a* toward *b*. Then align the edge with the pencil point and the third point (*c*). Lift the pencil and place it at a new pivot two-thirds of a unit from the first pivot. Realign the edge with the pencil and the next point of the data and continue in a similar manner until all the points have been used. The last pivot mark will be two-thirds of the total distance on the abscissa beween the first and last points of data. A corresponding terminal pivot point is obtained by beginning at the other end of the data and working back in steps of two-thirds of a unit. A line drawn through these two terminal points is the least squares line for the data considered. A simple check for errors may be made by graphically determining the $\overline{y}$ value by Askovitz' method (*1*)—that is, starting from either end of the data and moving by steps of one-half unit, a midpoint is obtained that is also on the best fitting line.

In the cases where it is known that the least squares lines should pass through point *a* (as in standard curves that are properly corrected for blank values), the construction simplifies to the following: start at point *b*, and progress by steps of two-thirds of a unit through all the remaining points. The termination is a point Ω that may be connected with *a* to give the best fitting line through this origin. Note that Ω and its reversed counterpart may also be used equally well in constructing the line *AB*, since the points lie on the original least squares line one-third of a unit beyond *A* and *B*, respectively.

In actual practice, when one uses decimal graph papers (preferably with accented lines every five divisions), it is convenient to choose a unit distance equal to either 15 or 30 of the smallest divisions. In this manner, moving two-thirds of a unit between pivot points always brings one to an accented line that facilitates the rapid execution of the maneuvers. On the other hand, if it is more important to make the unit a multiple of 10 for subsequent interpolations of *x* values, the unit may be taken as 20 of the smallest divisions. Here, 13 divisions between pivot steps will yield a line that is a very close approximation to the least squares line. It is suggested that if this graphic method of least squares lines becomes popular, the manufacturers of graph papers might consider producing a new design in which there would be two lines of a second color placed one-third and two-thirds of the distance between each unit of ten divisions. Such a paper would have the advantages of decimal convenience as well as ease of finding the pivot points.

Proof of second method. Let there be a set of *n* points designated $1,2,3 \ldots n_i \ldots n$, with *x* (on the transposed abscissa as in the first method) and *y* values for the individual points. Let α be the centroid composed of the plotted points of data but with each point weighted per its n_i value, starting from left to right. Let β be the centroid weighted per

$$n+1-n_i$$

(that is, from right to left), while γ represents the centroid in which all points have equal weight. *A*, *B*, and *C* will be the balance points of the centroids α, β, and γ, respectively, and *M* will be the midpoint of the line segment *AB*. It is shown that point *C* coincides with *M* as follows:

$$x_C = 0$$

and *C* lies on the least squares line, while

$$y_A = \overline{y}_\alpha$$
$$y_B = \overline{y}_\beta$$

and

$$y_C = \overline{y}_\gamma$$

As in Askovitz' method, but with weighted values, the balance point *A* is reached at two-thirds of the distance $(n-1$ units) from point 1 toward *n*, and point *B* is reached two-thirds of the way from *n* toward 1. It follows, then, that *A* and *B* are one-third of $(n-1)$ units apart and that the midpoint of the line *AB* is on the line $x=0$. Since α and β are arithmetic step wedges in opposite directions and with equally weighted extremes, superimposing these congruent centroids will result in a composite centroid with a balance point *M* midway between *A* and *B*. Each point in the new centroid, however, has a weight equal to

$$n_i + (n+1-n_i) = n+1$$

Therefore, M is the balance point of an equi-weighted centroid and coincides with C. The slope of the line AB is

$$3\left(\frac{\bar{y}_2-\bar{y}_1}{n-1}\right)$$

and that of the best fitting line is $\Sigma xy/\Sigma x^2$.

Substituting the proper values gives

$$\frac{3\left(\frac{\Sigma n_i y}{\Sigma n_i}-\frac{\Sigma[y(n+1-n_i)]}{\Sigma n_i}\right)}{n-1}=\frac{\Sigma xy}{\Sigma x^2} \quad (3)$$

When n is odd, Eq. 3 leads through

$$\frac{\Sigma n_i}{2}\left(\Sigma\left[y\left(x+\frac{n+1}{2}\right)\right]-\Sigma\left[y\left(\frac{n+1}{2}-x\right)\right]\right)=\Sigma xy\Sigma\left(x+\frac{n+1}{2}\right) \quad (4)$$

to

$$\Sigma n_i\Sigma xy=\Sigma n_i\Sigma xy$$

When n is even, Eq. 3 leads through

$$2\Sigma[y(x+n+1)/2]-(n+1)\Sigma y=\Sigma xy \quad (5)$$

to

$$\Sigma xy=\Sigma xy$$

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5 August 1955

Gases in Icebergs

Pure ice in thick layers is bluish in color, whereas an iceberg is typically white. The whiteness is caused by tiny, closely spaced gas cavities that are dispersed all through the ice. The cavities are often elongated and oriented lengthwise; this gives a grain to the ice. The gas is usually under pressure and is liberated with a fizzing sound when a piece of berg ice melts in a pail of water. With a lens one may watch the bubbles suddenly enlarge and pop out of their cavities when the walls melt open. The pressure is also manifested by the way chips almost fly off the ice at the slightest fracture. This is undoutedly caused by the release of compressed air from the bubbles into the fracture.

Either the gas bubbles in a iceberg could be atmospheric air trapped at the time snow was compacted into glacier ice, or, since gases are insoluble in ice (*1*), the bubbles could be frozen out of air-saturated water, as they are in ice cubes from a refrigerator. Water equilibrated with air at 0°C contains 2.9 percent by volume of dissolved gases, of which 34.9 percent is oxygen. Since air has only 20.9 percent oxygen, the concentration of this gas in the bubbles may tell whether the ice was formed by compacting the snow crystals or by freezing of a body of water (*2*).

The rate of gas diffusion through ice is no more than 1/40,000 to 1/70,000 as fast as it is through water (*1*). Considering this extremely slow rate, the relatively enormous diffusion distances in the glacier, and the large quantity of gases held under pressure in the ice, it would seem possible that gas trapped in the glacier would remain unchanged for millenia. Analysis of such gas could therefore give information about the atmospheric composition at the time the ice was formed.

This article (*3*) presents studies on pieces of icebergs taken on board the research vessel *Blue Dolphin* along the Labrador coast. Most icebergs in this area are of Greenland origin. In the interior of Greenland and the Antarctic, the temperature stays below freezing all year, and the glacier ice is formed by the compacting of snow under high pressure. These are the high polar glaciers. In glaciers of warmer climates, melt water percolates through the snow in the summer and freezes deeper down, as an important part of the firnification process (*4*). The gas in such ice should accordingly be more or less enriched with oxygen. Only the polar type of glacier would therefore seem suitable for possible clues to the composition of ancient atmospheric air. Isotope distribution could probably be studied in either type.

Although the techniques for obtaining samples from bubbles in icebergs have been generally adequate, the composition of the gas has been found by several authors to be more or less close to that of the atmosphere, and it has long been known that the gas is usually under pressure (*5*). In our work, we melted a piece of ice in mercury. The gas phase and the dissolved gases in the melt water were analyzed separately and the results were totaled.

A piece of berg ice was shaved to fit snugly into the barrel of a 20-ml syringe. The plunger was set in and mercury drawn in to cover the ice. The first milliliter of melt water and bubbles was discarded. The nozzle was closed with the finger, and the ice-and-mercury volume was read. The ice was quickly melted and a new volume reading taken. The gas phase was transferred to a tuberculin syringe to determine the volume, and it was analyzed for composition (*6*). The volume of meltwater w and mercury was read on the syringe and 1 ml of water was analyzed for dissolved oxygen and nitrogen (*7*). Carbon dioxide could not be determined accurately with the methods we had available. About 85 percent of the total amount of gas analyzed was in the gas phase.

The pressure of the gas in the ice was found as

$$g/x$$

where x is the volume of the compressed gas in the ice and g is the volume at 1 atm. This can be computed according to the formula

$$g/x=\frac{g}{v-1.091w}$$

where v is the volume of ice and bubbles and $1.091w$ is the volume of ice alone.

It can be estimated that the combined accuracy of the various measurements will amount to about ± 0.2 percent by volume for the total oxygen and nitrogen. The pressure estimates are probably valid to within ± 25 percent.

Thirty pieces taken from six different icebergs were analyzed. It will be seen from Table 1 that the oxygen content in all of the bergs is close to that of the atmosphere, that is, 20.9 percent. Nevertheless, the oxygen content of iceberg No. 5 and especially No. 6 was significantly lower. One may speculate that when the snow settled on the Greenland icecap ages ago and compacted into these pieces of glacier ice (No. 5 and No. 6), an atmosphere was trapped that is slightly lower in oxygen content than our present atmosphere (*8*). Possibly this ice was formed as far back as Pleistocene time, when cold climates may

Table 1. Gases in iceberg ice. Air-equilibrated water at 0°C contains 2.9 percent gas by volume, of which 34.9 percent is oxygen. Clear ice contains less than 0.003 percent gas, most likely none at all (*1*). The pressure determinations are based upon from two to eight analyses in each iceberg.

Iceberg No.	Ratio of compressed gas to ice (ml/100 ml)	Ratio of gas at 1 atm to melt water (ml/100 ml)	Gas pressure in ice (atm)	O_2 in gas (%)
1	1.9 to 2.2	4.2 to 8.3	2.9 to 3.9	21.4, 21.2, 21.2
2	2.3 to 3.8	7.7 to 11.1	2.3 to 3.9	20.9
3	1.2 to 2.2	4.8 to 9.3	2.0 to 6.2	21.2
4	1.1 to 2.6	2.9 to 6.5	1.0 to 5.0	20.6
5	1.0 to 2.4	2.2 to 8.8	3.3 to 5.8	20.2, 20.4
6	2.1 to 5.2	5.6 to 9.9	1.7 to 2.6	20.0, 20.0, 20.1, 20.1

have curbed photosynthetic activity of green plants over large parts of the earth, resulting in a slight lowering of the oxygen content of the air. Such a hypothesis can be verified only by better determinations of the diffusibility of gases through ice and by more accurate laboratory procedures for the extraction and analysis of the gas. No particulate matter could be detected in our ice pieces, but we cannot exclude the possibility of oxygen loss from dust oxidation. Whether or not enough organic material can be obtained from the ice for radiocarbon dating we do not know.

In our random investigation we did not encounter ice with gas bubbles rich in oxygen, which is suggestive of frozen, air-saturated water such as one might encounter in temperate-type glacier ice.

The bubbles in our icebergs were found to be under pressure, usually between 2 and 6 atm. Why the pressure seems to vary so much from one part of a berg to another is a puzzling problem. If such pressure gradients can persist in the bergs for a long time they might reflect something of the history of the berg such as the depth in the glacier from which it came.

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3. Contribution No. 818 from the Woods Hole Oceanographic Institution. This work was carried out on the *Blue Dolphin* Labrador Expedition, 1954, under the auspices of the Arctic Institute of North America, project ONR-138, with funds provided by the Office of Naval Research.
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Synthesis of Coffinite—$USiO_4$

A recent communication by Stieff, Stern, and Sherwood (*1*) gave a preliminary description of a new mineral, coffinite ($USiO_4$), which has become recognized as a major uranium mineral on the Colorado Plateau. Coffinite is described as a fine-grained black mineral; it is best identified by its x-ray powder pattern. The crystal structure is tetragonal, isomorphous with thorite ($ThSiO_4$). It was also noted that all attempts to synthesize $USiO_4$ had been unsuccessful to date. We have spent some time on attempts to prepare $USiO_4$, and our work has now progressed to the point where a preliminary report can be made describing the synthesis of coffinite by a hydrothermal process (*2*). The synthetic coffinite has been identified by its crystal structure, even though pure material suitable for chemical analysis has not been isolated.

Our procedure is, briefly, as follows: 1 mmole each of uranium tetrachloride and sodium metasilicate are dissolved in 10 ml of water. Sodium hydroxide solution is added dropwise to the uranium-silicate solution until a stiff gel forms near the neutral point. Enough additional base is added to make the mixture slightly alkaline (*p*H 8 to 10) (*3*). The gelatinous precipitate is then centrifuged and transferred to a vitreous silica tube, which is placed in an Inconel bomb tube. We carry out these operations in a nitrogen atmosphere to prevent oxidation of the uranium. Whether this precaution is necessary remains to be determined. Other variables in the procedure must also be evaluated. The sealed Inconel tube is heated 4 to 5 days at 250°C to crystallize the $USiO_4$.

Synthetic coffinite appears as a bluish-green solid in the reaction products. The material prepared to date appears to be isotropic under the microscope, but x-ray powder patterns confirm the presence of tetragonal crystals of coffinite. Quartz or cristobalite have been identified as contaminants in all the coffinite preparations that have been made to date. A comparison of lattice dimensions of natural coffinites with the synthetic material gives the following: Arrowhead Mine (*1*), Mesa County, Colo., $a = 6.93$ kx, $c = 6.30$ kx; Jack Pile Mine (*4*), Laguna, N. M. (AE1019), $a = 6.937$ kx, $c = 6.285$ kx; and synthetic coffinite (*5*) $a = 6.977$ kx, $c = 6.307$ kx. The refractive index of synthetic coffinite has been found to be 1.83 to 1.85.

We have heated the black, naturally occurring coffinite (AE1019) in air at 375°C to oxidize away the organic matter with which it is associated. The inorganic residue retains the tetragonal structure, but is then a gray-green color that is characteristic of tetravalent uranium compounds and quite similar to that of the synthetic coffinite.

Naturally occurring $USiO_4$ is reported (*6*) to decompose to UO_2 and amorphous silica when it is heated above 400°C, although Grüner (*7*) reports retention of the tetragonal structure of the Jack Pile Mine coffinite on ignition to 500°C. Our synthetic coffinite has been found to be thermally stable, in vacuum, for at least 5 hours at 700°C.

Work on coffinite, its preparation and its properties, is continuing and will be reported in more detail at a later date.

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4. This sample was obtained through the courtesy of J. W. Grüner of the University of Minnesota.
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7. J. W. Grüner, personal communication.

22 August 1955

Interference in Salkowski Assay of Indoleacetic Acid

The Salkowski reaction (*1*) has long been used as a simple assay for indole derivatives (*2*), although it is not entirely specific for them. In their study of the enzymatic destruction of growth substances, Tang and Bonner (*3*) utilized the Salkowski reaction as an assay for indoleacetic acid (IAA), one of the few compounds that gives a carmine-pink color with the reagent (*2*). Lately the reaction, especially in the modification of Gordon and Weber (*4*), has been widely used for the assay of IAA and other indole-containing growth substances, both in solution and on paper chromatograms. The colored product has recently been ascribed to hydroxylation of the indole nitrogen (*5*).

The assay method is, however, subject to interference from various sources. Siegel and Weintraub (*6*) and others have noted that peroxides interfere by making the pink color too fugitive to be measured, and Brauner (*7*) observed that the reaction is inhibited by light. The experiments described in this report show that a number of other commonly occurring compounds may regularly interfere with the assay and that important changes are caused by exposure to light during, before, or after color development (*8*).

Curve *A* in Fig. 1 shows the usual time course of the development of the pink color when the reagent of Gordon and Weber (*4*) is used. The sample, before reagent was added, contained $4 \times 10^{-5}M$ IAA (*9*). A stable maximum in curve *A* is reached in less than 30 minutes. If, however, the reagent has been exposed to bright light beforehand, the color development is greatly delayed (curve *B* in Fig. 1). Illumination of the reagent made up with sulfuric acid (*3*) also gives a color delay. Furthermore, a similar delay results if a ferrous salt is added to the reagent. Curve *B* duplicates almost exactly that produced by using a perchloric acid Salkowski reagent in which 7 percent of the prescribed iron is in the ferrous state. It seems probable that the effect of light results from the formation of a small amount of ferrous ion. The observation that x-rays can reduce ferric to ferrous ion even in the presence of perchloric acid (*10*) is a precedent for this interpretation.

It might be thought that, with care to keep the complete reagent in a minimum of light, ferrous interference could easily be dismissed from routine Salkowski assays. But, unfortunately, such interference may also be observed when the assayed sample contains reductants such as hydroquinone, ascorbic acid, or cysteine. Ascorbic acid, for example, at $4 \times 10^{-4}M$ produces a color delay effect that would correspond to an almost stoichiometric reduction of the iron in the reagent.

Inasmuch as the color development

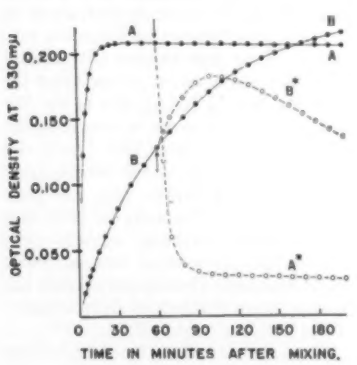

Fig. 1. Time course of Salkowski color development. (Curve A) "Normal" development, method of Gordon and Weber (*4*), $4 \times 10^{-5}M$ IAA in sample; (curve B) same as curve *A* but with Gordon and Weber reagent exposed to about 500 ft-ca of white light (fluorescent tube) before use; (curves A^* and B^*) arrows indicate time of start of exposure of reaction mixtures *A* and *B*, respectively, to white light.

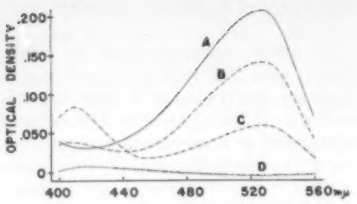

Fig. 2. Absorption spectra of samples after one hour's reaction with Salkowski reagent, measured against a water-diluted Salkowski reagent blank. (*A*) $4 \times 10^{-5}M$ IAA; (*B*) $4 \times 10^{-5}M$ IAA and $4 \times 10^{-5}M$ catechol; (*C*) $4 \times 10^{-5}M$ IAA and $2 \times 10^{-4}M$ catechol; (*D*) $2 \times 10^{-4}M$ catechol.

may be delayed by Fe^{++} and other reductants and accelerated by H_2O_2, it seems probable that the normal color is due to a slow oxidation. For assays of IAA alone, the unmodified color development is usually satisfactory, but indoleacetonitrile, for example, reacts very slowly with the standard reagent. The addition of a small amount of H_2O_2 (about $3.10^{-5}M$) to the mixture hastens color development and somewhat improves the maximum intensity reached with this compound.

It is notable that the rapidly formed ferric-IAA color (curve *A* of Fig. 1) is much more sensitive to bleaching than the color formed in the presence of ferrous ion (curve *B*). After 1 hour of dark development, replicate mixtures were exposed to the light of one fluorescent tube (about 500 ft-ca). The subsequent density changes in the "normal" are shown in curve A^*; within 10 minutes, the color has been bleached to less than a third of the maximum developed in the dark. The ferrous-delayed color reacts as shown in curve B^* when it is exposed to the same light. The color development is slightly accelerated for about 40 minutes, after which a slow bleaching ensues.

Another type of interference with the Salkowski reaction has been observed in dealing with plant extracts. Curve *A* in Fig. 2 shows parts of the absorption spectrum of the colored product that was formed when the perchloric reagent (*4*) was used on a sample containing $4 \times 10^{-5}M$ IAA. If such a sample contains, in addition to IAA, an equimolar concentration of catechol, as in curve *B* of Fig. 2, there is no delay in the color development, but the final density of the reaction mixture at 530 mμ is decreased by about 30 percent. Curve *C* shows the absorption spectrum 1 hour after Salkowski reagent was mixed with a solution containing both $4 \times 10^{-5}M$ IAA and $2 \times 10^{-4}M$ catechol. When this concentration of catechol alone has reacted with the reagent for 1 hour (curve *D*), it is hardly detectable by any absorption in the given range; but when it is included in the sample with IAA, it diminishes by more than 70 percent the absorption at 530 mμ that is expected from the ferric-IAA reaction. It is also evident in Fig. 2, curve *C*, that the ferric-IAA-catechol mixture develops an absorption peak near 410 mμ even at these low concentrations of catechol. This suggests that the ferric ion in this case is catalyzing an additional reaction in which both IAA and catechol participate.

Other polyphenols such as resorcinol, phloroglucinol, and hydroquinone also inhibit the development of the pink ferric-IAA absorption, but the interference by hydroquinone and some other phenols (for example, catechin) is particularly complicated, perhaps through combining the catechol type of interference with a simultaneous reduction of Fe^{+++}.

Reducing agents and polyphenols are so widespread in plants, and so drastic in their Salkowski interference, that the Salkowski assay, either in solution or on chromatograms, should be considered uncertain when one is dealing with any but the most highly purified of plant extracts. On the other hand, the recognition of these effects on the test may well suggest other important characteristics of the assayed material (*11*).

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10 August 1955

Book Reviews

Legal Medicine. Pathology and Toxicology. Thomas A. Gonzales, Morgan Vance, Milton Helpern, and Charles J. Umberger. Appleton-Century-Crofts, New York, ed. 2, 1954. 1297 pp. $22.

This extremely well-organized textbook is more fascinating than the most skillfully written detective story or the best-illustrated treatise on pathology, perhaps because the intriguing elements of each are so thoroughly blended. It is much more than an excellent textbook on pathology written with emphasis on items in the specialty that have medicolegal importance; it is a carefully integrated book in which the contributions of medicine and law are fused.

As in the previous edition, the major portion of the volume is devoted to pathological problems in forensic medicine —that is, medical problems arising in the professional practice of law.

The first edition in 1937 contained 706 pages and a 14-page appendix on the organization and statistics of the Office of the Chief Medical Examiner of the City of New York. The second edition has been increased to 1297 pages; it has a 14-page appendix on qualitative chemical analysis and the text of the law that established the Office of the Chief Medical Examiner of the City of New York. The index of the present volume, as in the case of the original edition, is a respectable 2.7 percent of the total number of pages. In addition, there is a greater than usual amount of cross-referencing in the text itself, which makes for ease in locating all data on each topic.

The three chapters on medical jurisprudence, a term limited by the authors to the area of the law that is concerned with the regulations governing the professional practice of physicians, have been increased from 17 pages to a total of 47 with an added section on medical testimony in court. The topic of malpractice has been expanded to 12½ pages, the section on insanity to 18. Invaluable advice is given to the physician who is called to handle an emergency.

Occupational toxicology, a specialty in itself with obvious medicolegal aspects, is adequately covered.

The chapter on ethyl alcohol has a penetrating analysis of the medicolegal aspects of intoxication combined with a careful evaluation of experimental work on this subject. In this chapter, there are cross references to an earlier section on the influence of alcohol on trauma and the medicolegal aspects of the handling of injured alcoholics.

The volume should be helpful to law students who are engaged in preparing cases for trial in moot court and will be an especially valuable basic reference for the practicing attorney. It should find its place with the standard hornbooks on various areas of the law. The explanations of the effect of fatal variance between pleadings and evidence, burden of proof, directed verdict, and the doctrine of *res ipsa loquitur* are unusually clear. An excellent illustration of causal relationship is found in the material on fatalities following surgery. The section on malpractice, equally valuable to medical and to law students, is a concise exposition of tort action arising out of contract.

There is an interesting presentation, in a few words, of the origins of the coroner system, its disadvantages, and the growing trend to its replacement by the medical examiner system. The excellence of the book itself, which was written by members of the Office of the Chief Medical Examiner of the City of New York, is a very convincing argument for the medical examiner system.

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Photosynthesis. Monograph on biochemical subjects. Robert Hill and C. P. Whittingham. Methuen, London; Wiley, New York, 1955. vii + 165 pp. Illus. $2.

In a field as diverse and complex as photosynthesis, space limitations force writers of review articles to produce either specialized discussions of narrow fragments of the field or accounts so brief that they are little better than annotated bibliographies. Complete monographs (such as the excellent two-volume work, *Photosynthesis*, by E. Rabinowitch) tend to become veritable encyclopedias, which are so long and involve so many different disciplines that few, if any, experts could claim to be competent in all parts of the material covered. For these reasons, Hill and Whittingham's short monograph is especially welcome. It should serve admirably as an introduction to photosynthesis or as a general review for those who specialize in some restricted phase of the subject.

Although this book is, generally speaking, a popular account, it does demand some familiarity on the part of the reader with the facts and language of chemistry and physiology. It is a readable book, with few tables and no footnotes. Its authors have maintained a good balance between the theoretical and experimental approaches to the subject. All important aspects of photosynthesis are adequately outlined, but the biochemistry of the problem is treated in somewhat greater detail than are its physiology and physical chemistry. I noticed a few minor misstatements in Chapters 2 and 3, but they are probably of interest only to specialists.

This monograph should be read by biochemists and physiologists and, indeed, by everyone who is interested in the fascinating problem of photosynthesis.

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Kinships of Animals and Man. A textbook of animal biology. Ann H. Morgan. McGraw-Hill, New York, 1955. 839 pp. Illus. $6.75.

When I was asked to review this book, I agreed, thinking it was about the kinships of animals and man, about the ever-fascinating problem of man's place in nature. To my surprise, the book turned out to be a quite conventional introductory textbook of zoology. Why do we have this current fashion of putting *man* into the titles of biological books and biological courses? When it is the same old material, served up in the same old way, it looks like some kind of a trick to catch the trade. The general education people have a point, I think, in trying to encourage biologists to stress human implications in some of their courses; but the biologists are hardly cooperating by the lip service of changing titles only.

As far as I can judge, Ann Morgan has written a good introductory textbook for zoology. She starts out with a section on "The foundation," which covers some of the elementary ideas of physics, physical chemistry, and cellular physiology in a simple-minded sort of way, probably appropriate for ignorant freshmen. She then, in part 2, devotes three chap-

ters to ecology. This introduction of ecological concepts early seems to me an excellent idea. She might have caught student interest more easily by starting with this, leaving matter, energy, and cellular mysteries for some later part of the book. The third section of the book, called "The internal environment of the body," is a rather lengthy review of organ systems, with primary attention to vertebrates (including man). Development and heredity are then disposed of in two short chapters. The fifth and longest section of the book is called "Evolution and animals," but it is really a straightforward review of the invertebrate phyla and the vertebrate classes. Evolution itself is covered in a short terminal chapter. The book is liberally and often very aptly illustrated, sometimes with striking pictures from little-known sources.

How one would choose between this book and a dozen or so others in selecting a textbook for a course, I do not know. This has almost everything: the phyletic approach, the functional approach, the ecologic approach, along with occasional bows to human physiology and anatomy, and some nice pictures.

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Krebiozen: the Great Cancer Mystery. George D. Stoddard. Beacon, Boston, 1955. ix + 282 pp. $3.50.

Often the violence of controversies over the treatment of a disease has been proportional to ignorance or to lack of knowledge that was either nonexistent, or withheld, or both. When tensions are further stretched by elements in a disease of overwhelming importance to suffering mankind and by factors of prestige and money intermingled with idealism and scientific purposes, when the situation is obfuscated by secretiveness and suspicions of quackery and tautened by institutional, governmental, political, and religious interests, there is likely to be an explosion. Since cancer research contains all of these elements, explosive controversies over the treatment of cancer have occurred in the past. The most recent and severe is the controversy over the claims for krebiozen as an agent for the treatment of malignant tumors. This controversy is the subject of this book by George D. Stoddard, former president of the University of Illinois.

The chief "mystery" in the story is the incompletely disclosed nature of krebiozen. The material is said to have been obtained by Stevan Durovic, in costly experiments in Argentina, by extraction from the blood of horses that he had treated in some manner to stimulate the reticulo-endothelial system. Only a small quantity of the material (about 2 grams) was obtained, and this was dissolved in a large quantity of mineral oil and put up in many thousands of ampoules. Apparently, none of the "powder" has been made available for independent analysis and testing. Hence krebiozen is in the class of secret remedies.

In 1949 or 1950, Durovic interested Andrew C. Ivey in his claims for the value of krebiozen for the treatment of cancer. In 1951, Ivy presented a report on it at a semipublic meeting at the Drake Hotel in Chicago. Thereafter, clamor arose and a series of events started that resulted in conflicts involving the faculty and trustees of the University of Illinois, in arousing criticism and opposition of the American Medical Association and the Chicago Medical Society, and in precipitating an investigation by the legislature of the State of Illinois. The conflict had a bearing upon the forced resignation of Stoddard as president of the University of Illinois and the deprival of Ivy of his position as one of the university's vice-presidents.

The story is told in detail in the first 139 pages of the Stoddard volume. The second part (pp. 140–274) is an appendix of reproductions of documents and excerpts from documents in the case. There is a good index at the end. The body of the book is well organized and written in a lively dramatic style.

This book about a controversy involving academic freedom aroused a controversy over the freedom of the press. An unsuccessful attempt was made by the opposing side to have the book suppressed by legal injunction in Massachusetts prior to its publication.

While much of this story is as tragic as it is interesting, the main question whether or not krebiozen is of any value in the treatment of cancer is still the important consideration. Others not directly connected with Durovic and Ivy, notably the Cole Committee, have found that the claims made for krebiozen were not warranted. In the opinion of the Cole Committee, krebiozen has no curative value in the treatment of cancer. The committee suggested that further studies of its possible ameliorating effects might be considered, but that it would be futile and inconclusive to conduct further investigations unless the chemical nature and properties are determined and disclosed under conditions by which the financial and scientific interests of the originators will be protected.

For the testing of proposed treatments of cancer, there are some excellent plans and places in the United States. In these, full disclosure of information is shared by investigators and referees. On the other hand, obstacles, almost insuperable, interpose themselves when the remedy is a secret. In spite of both of these considerations there is a need to strengthen and broaden this testing system. This, however, is part of the larger problem of making arrangements for the clinical testing of new drugs.

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Forestry and Related Research in North America. Frank H. Kaufert and William H. Cummings. Society of American Foresters, Washington, D.C., 1955. viii + 280 pp. $5.

This book presents a concise and well-written report on a reexamination of the entire structure of forestry research programs in the United States, Canada, and Mexico. A reappraisal at this time would determine whether the progress being made in research is adequate in the light of the importance of forest resources in the economic and social welfare of the nation. This report, which covers 15 subject-matter sections, is unquestionably the most comprehensive treatment of a national program for forestry research ever published. It not only deals with timber resources, their products and utilization, but also includes the aspects of wildlife, range, watershed, and recreation that have their basis in forest lands. The purpose of the report is well summarized in the statement: "Research has played a major role in the development and utilization of the forestry and related resources of the nation. It can be an even greater determining factor in the future if developed along the lines suggested in this report."

Of particular interest is the excellent history of the development of forestry research. The first trained scientist to study the forests of North America was the French botanist André Michaux, who in 1785 was sent here by the French Government. There are numerous tables that show various classifications of expenditures by the major research fields. Of greatest interest to all specialists will be the 15 subject-matter sections that make up two-thirds of the book. The survey data for each subject section —that is, genetics, soils, silviculture, ecology, and forest management—are clearly and concisely summarized as follows: (i) development and accomplishments, (ii) expenditures and personnel, (iii) problems requiring research, and (iv) recommendations. These data furnished the basis for the chapters on "The national program summarized" and "Recommendations and goals for the next quarter-century."

Brief mention should be made of some of the salient points brought out by the survey. On the basis of expenditures, more than two-thirds of the research was in the fields of forest products and utilization. Forestry schools play a major role in training research personnel and in the conduct of basic research. There is need for fellowships of $3000 to $4000 per year to attract qualified men for graduate training in sciences basic to statistics, silviculture, and other specialties. Agencies with adequate financing were conducting more quality research than those with limited funds. A serious shortage of qualified and well-trained personnel is critical in most fields, especially genetics, soils, and and wood technology. Cooperation in research dealing with forestry and related fields is as yet poorly developed. There appeared to be no lack of publication outlets for short papers, but a serious problem exists with long papers. Most scientific journals have considerable backlogs of manuscripts. Without reservations, I believe that this book will offer to all foresters, as well as to specialists in related fields, a rich background in the research that will be needed for the future development of one of the nation's greatest resources.

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The History of the Telescope. Henry C. King. Sky Publishing, Cambridge, Mass.; Griffin, London, 1955. xvi + 456 pp. Illus. $12.50.

A number of books, both popular and advanced, have included sections on the history of the telescope. However, H. C. King's book is the first major work devoted exclusively to its history. In 19 chapters averaging more than 20 pages each, King covers astronomical observations from pretelescopic times to the latest developments in optical and radio-telescopes. The book is profusely illustrated with drawings and photographs. Detailed references at the end of each chapter (for example, 90 at the end of Chapter I, 42 at the end of Chapter II) make the work invaluable for any professional astronomer or serious amateur.

Chapter I is a discussion of observational astronomy prior to the invention of the telescope, which culminated in the monumental work of Tycho Brahe. Chapter II is a discussion of the history of optics. Here King tries to evaluate the evidence regarding the identity of the true inventor of the telescope. Chapter III describes Galileo's construction of the first astronomical telescope and the work he did with it. Chapter IV and the following chapters describe the inventions and technologic improvements that have led to the large telescopes of the present day. Attention is paid to the specialized optical needs of different branches of observational astronomy. The book concludes with a 13-page index.

Everyone who is interested in the history of the telescope is indebted to King for writing such a fine book and to the Sky Publishing Corporation for producing it in such attractive form.

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Problems and Control of Air Pollution. Proceedings of the First International Congress on Air Pollution held in New York City, 1–2 March 1955 under the sponsorship of the Committee on Air-Pollution Controls of the American Society of Mechanical Engineers. Frederick S. Mallette, Ed. Reinhold, New York; Chapman & Hall, London, 1955. vi + 272 pp. Illus. $7.50.

In recent years, the interest of scientific and technical groups in air pollution has increased rapidly, resulting in an epidemic of symposia at which the expanding activities in this field are reported and discussed. The proceedings of many of these meetings have been published as pamphlets, as special sections of technical magazines, and occasionally in book form, as in the present instance. F. S. Mallette has assembled the 25 papers presented at the First International Congress on Air Pollution, held at the American Society of Mechanical Engineers 75th anniversary meeting in New York, 1–2 March 1955.

The book was therefore written by 30 authors in addition to the editor, since several of the papers were written by two or more persons. Each paper comprises a chapter in the book. Four of the authors are from England, two from Canada, two from the Netherlands, and one each from Portugal, Italy, and France, and the rest from the United States. The group consists of distinguished experts.

The first two chapters deal with the history of the subject, with public opinion, and with the role of industrial management. The next five chapters were grouped together by the editor because they all stress the gaps in existing knowledge regarding air pollution and the need for futher research. However, these five chapters are very diverse, dealing with biological, geographic, engineering, meteorological, and health aspects of air pollution.

The next four chapters describe current developments, again in diverse fashion, from diesel exhaust and incinerators to optical measurements of aerosol particle size, and an atmospheric survey of Sarnia, Ontario.

The next eight chapters are less diversified, for they all relate to sulfur, sulfur dioxide, and hydrogen sulfide. Three discuss power plant stack gases, one deals with oil refineries, one with the steel industry, one with coke ovens, and one with the chemical industry. The initial chapter in this group is concerned simply with the world supply of sulfur, with air pollution as an incidental consideration.

The final five chapters relate to experience in air pollution abroad, in Holland, Portugal, Italy, and France. The first chapter in this group connects the the efficiency of a Cyclone with the size of its outlet pipe. The third chapter describes forest damage by air pollutants from a smelter and from oil engine exhaust. The other three chapters are more general in scope.

The book should be a valuable and convenient reference for the large and growing group interested in this subject.

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Chemistry and Chemical Technology of Cotton. Kyle Ward, Jr., Ed. Interscience, New York–London, 1955. xix + 782 pp. Illus. $20.

Textile technologists have been exceptionally fortunate in the past 2 years in having had made available to them three quite exceptional surveys of the properties of textile fibers. The first of these, *Textile Fibers, Yarns & Fabrics,* by Ernest R. Kaswell, presented a broad review of fiber properties in relation to the functional characteristics of textiles with special reference to wool. The second, *Harris' Handbook of Textile Fibers,* is more a compendium of data from various sources on fiber and fabric properties without special orientation toward particular materials. The third, which has now become available, is, in a sense, a corresponding volume on cotton fibers and fabrics.

A comparative study of the three works shows interesting relationships as well as contrasts. The Kaswell book places much emphasis on the physical and mechanical properties of textile fibers. The new book by Kyle Ward on cotton, in contrast, is focused to a large extent on the chemistry of cotton. Perhaps this is the more important approach to the study of cotton, and readers will certainly be grateful to Ward for the comprehensiveness with which he has surveyed the field and brought together

in such a useful volume so much about the cotton fiber that is actually related to industrial practices and processes.

The book follows a sequential treatment of the processing of cotton, starting with the chemistry of the raw cotton, then following with a discussion of the weaving, followed by a discussion of wet process finishing, including bleaching, dyeing, and printing, and then discussions of special functional finishes.

A symposium of this type, in which the work of some 20 different authors is represented, shows actually more uniformity of treatment than one might expect. This is a credit to the editor and his associates, who have done a fine job of editing.

A book of this kind will be very useful to technical people in the industry itself. Through books of this technical level, industry is being provided with a type of technical literature of a high order, which will add to the stature of textile technology as a professional field. Such books also introduce students coming into the profession to the many great technical contributions that have been made during the past two decades.

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Petrographic Mineralogy. Ernest E. Wahlstrom. Wiley, New York; Chapman and Hall, London, 1955. vii + 408 pp. Illus. $7.75.

This is the fourth book by Ernest Wahlstrom, of the department of geology of the University of Colorado. The first three—namely *Optical Crystallography, Igneous Minerals and Rocks,* and *Theoretical Igneous Petrology*—were needed to fill gaps in the ranks of elementary textbooks in their respective fields and have been well received. *Petrographic Mineralogy* consists in the main of selected portions of Wahlstrom's earlier works, together with a small amount of material that he has not previously presented.

In the preface, the author states that "The book is designed for a semester course of the type that normally would follow a course in the theory and operation of the polarizing microscope." Thus the book attempts to summarize information on the following: petrographic techniques, both microscopic and otherwise, including the universal stage; petrogenetic calculations; most of the rock-forming and the more common accessory minerals; and the compositions, properties, and classifications of igneous, sedimentary, and metamorphic rocks. This is not only a heavy load to be borne by the average student during a single semester, but it is likewise an inordinate burden for a textbook of 408 pages.

Chapter 1, "The collection and preparation of samples," is largely new. Chapter 2, "Petrographic techniques," describes mineral separation by means of magnetic methods, electrostatic methods, heavy liquids, and so forth. Most of this material is taken verbatim from *Igneous Minerals and Rocks,* pages 42 to 46. Also in this chapter, the section on physical characters in hand specimens, x-ray examination, staining techniques, and so forth, largely comes from Chapter 3 of *Igneous Minerals and Rocks.* Additions here mention examination by means of the electron microscope and differential thermal analysis.

"Microscopic examination of minerals and aggregates" is the title of Chapter 3. The introduction to this chapter is very similar to the introduction to Chapter 2 of *Igneous Minerals and Rocks.* The second part of this chapter, "Micrometric methods," is a somewhat revised version of what appears on pages 255 to 257 of *Igneous Minerals and Rocks.* In the third part, "Physical properties of minerals under the microscope," the description follows essentially that presented in *Igneous Minerals and Rocks* starting on page 10. Here also begins the repetition of many of the photographs previously used.

In Chapter 4 are presented descriptions of the universal stage and universal stage techniques. Some of this material has not been included in any of the previous books, but much of it represents an expansion of Appendix A in *Optical Crystallography.* It seems to me that the inclusion of this technique is not appropriate to an elementary course in microscopic petrography. Similarly in Chapter 5, which is entitled "Graphical presentation of data and common petrographic calculations," material is taken in large part from *Igneous Minerals and Rocks* and also to some extent from *Theoretical Igneous Petrology.*

The description of the rock-forming minerals begins with Chapter 6 (silicates), continues through Chapter 7 (nonsilicates) and concludes with Chapter 8 (Tables for Mineral Identification). Most of this material has been presented in similar form in *Igneous Minerals and Rocks.* Also, most of the illustrations have appeared before in the earlier book; only a few are new. One photomicrograph of labradorite not only has been used before but appears twice in *Petrographic Mineralogy* (pages 27 and 111). The tables for identification likewise are similar, except that some nonigneous minerals have been added. In *Igneous Minerals and Rocks,* Table 2 was presented as a series of descriptive listings; in *Petrographic Mineralogy* it is presented in a more abbreviated semidiagrammatic form. Chapter 9, "Composition, properties and classification of igneous rocks," stems almost directly, in abbreviated form, from Chapters 7 to 11 of *Igneous Minerals and Rocks*; but Chapter 10, "Composition, physical properties and classification of sedimentary rocks," and Chapter 11, "Composition, properties and classification of metamorphic rocks," have not been presented previously. Together these two chapters include about 65 pages. In contrast to the chapter on igneous rocks, that on sedimentary rocks presents almost no photomicrographs.

The book is uneven in the instructional level of its various parts. The quality of the petrographic descriptions hardly matches the higher horizon of the optical crystallographic work set by the inclusion of the universal stage methods.

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Chemotherapy of Malaria. Gordon Covell, G. Robert Coatney. John W. Field, Jaswant Singh. World Health Organization Monogr. Ser. No. 27. World Health Organization, Geneva, 1955. 123 pp. Illus. $3.25.

This book, written conjointly by four experts who reside in different parts of the world, brings together in a compact form factual information on the properties and usefulness of drugs commonly used in the treatment of malaria.

Chapter 1 describes the enormous strides that have been made in the chemotherapy of malaria since the time during World War II when quinine became unavailable to the Allies. The first phase involved intensive studies in this country of the physiological disposition of quinacrine (Atabrine) that led to the adoption of improved dosage schedules and raised the status of quinacrine from that of a poor substitute for quinine to that of a drug superior to it. With application of the new knowledge to the Pacific area, malaria soon ceased to be a major threat to the Allied troops. The second phase, the search for a better drug, culminated in chloroquine, a safer and more effective drug than quinacrine as a suppressive agent and for the treatment of the acute infection. At about the same time, British scientists produced proguanil (Paludrine), a radically new type of compound. The third phase, the development of compounds that would prevent relapses by eradicating the tissue forms of the malaria parasite, yielded primaquine, which has proved to be successful in the radical cure of the disease.

Chapter 2 reviews the basic features of

the biology of malarial infection and the chemical considerations that have led to the development of the varous antimalarial drugs.

Chapter 3 details the properties of the important antimalarial drugs, including methods for their estimation, their fate and physiological disposition in the body, their toxicity, and their effects on the various forms that comprise the life cycle of the malaria parasite. The information is up to date; it includes studies on the recently developed and extremely potent drug pyrimethamine (Daraprim). It is shown how chlorguanil and perhaps pyrimethamine represent an important chemotherapeutic advance because, in addition to curing acute attacks by affecting the asexual blood forms, they are lethal to the preerythrocytic forms of certain plasmodia and are therefore true causal prophylactics. In addition, these compounds exert a unique sterilizing effect on the sexual forms in blood (gametocytes), making them noninfectious to mosquitoes.

Chapter 4 describes the phenomenon of acquired drug resistance, which is rare for quinine, quinacrine, and chloroquine but which threatens to compromise the potential advantages of proguanil and pyrimethamine. Various theories concerning the development of resistance to these drugs are presented.

Chapter 5 outlines the clinical usages of the compounds. This valuable chapter presents the major principles and objectives of malarial therapy—prophylaxis, treatment of acute attack, and radical cure—and describes the role of each drug in therapy.

This volume is recommended for the physician rather than for the pharmacologist or biochemist because its emphasis is on the effect of drugs on the malaria parasite in its various forms rather than on basic pharmacological or biochemical considerations.

BERNARD B. BRODIE
National Heart Institute

New Books

Energy and Structure in Psychoanalysis. Kenneth Mark Colby. Ronald Press, New York, 1955. 154 pp. $4.50.

Mass-Transfer Operations. Robert E. Treybal. McGraw-Hill, New York, 1955. 666 pp. $9.50.

Physics of Fibres. An introductory survey. H. J. Woods. Inst. of Physics, London, 1955. 100 pp. 30s.

The Flood and Noah's Ark. Studies in Biblical Archaeology No. 1. André Parrot. Trans. by Edwin Hudson. Philosophical Library, New York, 1955. 76 pp. $2.75.

Humidity. H. L. Penman. Inst. of Physics, London, 1955. 71 pp. Paper, 5s.

Errors of Observation and Their Treatment. J. Topping. Inst. of Physics, London, 1955. 119 pp. Paper, 5s.

Handbook of Tropical Aquarium Fishes. Herbert R. Axelrod and Leonard P. Schultz. McGraw-Hill, New York, 1955. 719 pp. $10.

The Illustrated Reference on Cacti and Other Succulents. Edgar Lamb. Pitman, New York, 1955. 311 pp. $10.

Control of Nuclear Reactors and Power Plants. M. A. Schultz. McGraw-Hill, New York, 1955. 313 pp. $7.50.

Dictionary of Early English. Joseph T. Shipley. Philosophical Library, New York, 1955. 753 pp. $10.

The Dispensatory of the United States of America. Arthur Osol and George E. Farrar, Jr. Lippincott, Philadelphia, ed. 25, 1955. 2139 pp. $25.

Aspects of Synthesis and Order in Growth. Dorothea Rudnick, Ed. Princeton Univ. Press, Princeton, N.J., 1954. 274 pp. $6.

Psychosomatics. Max Hamilton. Wiley, New York, 1955. 225 pp. $4.25.

The Principles of Chemical Equilibrium. With applications in chemistry and chemical engineering. Kenneth Denbigh. Cambridge Univ. Press, New York, 1955. 491 pp. $7.50.

On the Wings of the Wind. David C. Holmes and Marvin Pitkin. McBride, New York, 1955. 204 pp. $3.50.

Final Contributions to the Problems and Methods of Psychoanalysis. vol. III of *Selected Papers of Sandor Ferenczi.* Michael Balint, Ed. Trans. by Eric Mosbacher *et al.* Basic Books, New York, 1955. 447 pp. $6.50.

Growing Nuts in the North. Carl Weschcke. Webb, St. Paul, Minn., 1953. 124 pp.

Inorganic Qualitative Analysis. Semimicro technique with estimation of concentrations. Harold A. Fales and Frederic Kenny. Appleton-Century-Crofts, New York, ed. 3, 1955. 284 pp. $3.50.

Soviet Professional Manpower. Its education, training, and supply. Nicholas DeWitt. National Science Foundation, Washington, 1955 (Order from Supt. of Documents, GPO, Washington 25). 400 pp. $1.25.

Bibliography of the Literature on the Minor Elements and Their Relation to Plant and Animal Nutrition. vol. IV. Chilean Nitrate Educational Bureau, Inc., New York, ed. 4, 1955. 150 pp.

International Encyclopedia of Unified Science. vol. 1, pts. 1 and 2 (10 numbers of vol. I of the *International Encyclopedia of Unified Science* in two volumes). Otto Neurath, Rudolf Carnap, and Charles Morris, Eds. Univ. of Chicago Press, Chicago, 1955. 760 pp. $6, each; 2 vols., $11.

The Tower of Babel. Studies in Biblical Archaeology No. 2. André Parrot. Trans. by Edwin Hudson. Philosophical Library, New York, 1955. $2.75.

Numerical Mathematical Analysis. James B. Scarborough. Johns Hopkins Univ. Press, Baltimore, and Geoffrey Cumberlege, Oxford Univ. Press, London, ed. 3, 1955. 554 pp.

Stratigraphic Geology. Maurice Gignoux. Trans. from French ed. 4, 1950, by Gwendolyn G. Woodford. Freeman, San Francisco, 1955. 682 pp. $9.50.

Analytic Geometry and Calculus. Thurman S. Peterson. Harper, New York, 1955. 456 pp. $5.50.

Advances in Catalysis and Related Subjects. vol. VII. W. G. Frankenburg. V. I. Komarewsky, and E. K. Rideal, Eds. Academic Press, New York, 1955. 362 pp. $9.

Principles and Practice of Field Experimentation. Tech. Communication 18. John Wishart and H. G. Sanders. Commonwealth Bur. of Plant Breeding and Genetics, Cambridge, Eng., ed. 2, 1955. 133 pp. 21s.

Proceedings of the Thirty-Fourth Annual Meeting, Highway Research Board. Fred Burggraf, Elmer M. Ward, and Walter J. Miller, Eds. National Acad. of Sciences–National Research Council, Washington, 1955. 648 pp. $8.50.

In Quest of Knowledge. A historical perspective on adult education. C. Hartley Grattan. Association Press, New York, 1955. 337 pp. $4.75.

The Biochemistry of Vitamin B_{12}. A symposium held at the London School of Hygiene and Tropical Medicine on 19 February 1955. Biochemical Soc. Symposia No. 13. R. T. Williams, Ed. Cambridge Univ. Press, New York, 1955. 123 pp. $3.75.

Elementary Topology. Dick Wick Hall and Guilford L. Spencer, II. Wiley, New York; Chapman & Hall, London, 1955. 303 pp. $7.

Solid State Physics. Advances in research and applications. Frederick Seitz and David Turnbull. Academic Press, New York, 1955. 469 pp. $10.

New Zealand Geomorphology. Reprint of selected papers 1912–1925. C. A. Cotton. New Zealand Univ. Press, Wellington, 1955. 281 pp. 42s.

Carl Friedrich Gauss: Titan of Science. A study of his life and work. G. Waldo Dunnington. Exposition Press, New York, 1955. 479 pp. $6.

Observational Astronomy for Amateurs. J. B. Sidgwick. Faber and Faber, London, 1955 (Distr. by Macmillan, New York 11). 358 pp. $10.

The Moon. A complete description of the surface of the moon, containing the 300-inch Wilkins lunar map. H. Percy Wilkins and Patrick Moore. Macmillan, New York, 1955. 388 pp. $10.

Fibrous Proteins and Their Biological Significance. Symposia of the Soc. for Experimental Biology, No. IX. Academic Press, New York, 1955. 370 pp. $8.

Functional Otology. The practice of audiology. Morris F. Heller, Bernard M. Anderman, and Ellis E. Singer. Springer, New York, 1955. 225 pp. $5.50.

The Barren Ground Caribou of Keewatin. Museum of Natural History, Misc. Publ. No. 6. Francis Harper. Univ. of Kansas, Lawrence, 1955 (Order from Arctic Inst. of North America, Washington, D.C.). 163 pp. $1.50.

Analytic Geometry. Clyde E. Love and Earl D. Rainville. Macmillan, New York, ed. 5, 1955. 302 pp. $4.

A Textbook of Sound. Being an account of the physics of vibrations with special reference to recent theoretical and technical developments. A. B. Wood. Macmillan, New York, 1955. 610 pp. $6.75.

The Alkaloids, Chemistry and Physiology. vol. V, *Pharmacology.* R. H. F. Manske, Ed. Academic Press, New York, 1955. 388 pp. $9.50.

Scientific Meetings

Council for International Organizations of Medical Sciences

Biologists from nine countries who attended a meeting convened in Paris by the Council for International Organizations of Medical Sciences at the request of UNESCO have submitted to UNESCO's Director-General a plan of action to encourage international or regional research on normal and abnormal cell growth. The meeting recommended in particular that an international committee be formed to collect information on research now in progress in this field, pointing out that UNESCO could perform valuable services to current research through such clearing-house facilities. The biologists asked UNESCO to pay special attention to research on the frequency of different types of diseases, according to regions.

They further recommended the organization of meetings, the award of fellowships for scientists, and the institution of special training courses on a regional basis on such subjects as tissue culture techniques and the use of special instruments. They asked that UNESCO study the need for an institute in Europe to raise inbred strains of laboratory animals.

Problems of growth, multiplication, and differentiation of cells are at the root of life, both animal and vegetable, it was pointed out. While the research program under consideration is intended to investigate only the fundamental processes of the cell, this research may also shed light on certain abnormalities such as cancer.

The meeting lasted from 12 to 16 Dec. and was attended by representatives from the following countries: Belgium, France, Germany, India, Israel, the Netherlands, Sweden, United Kingdom, and United States. This country's delegate was H. L. Stewart of the National Cancer Institute, Bethesda, Md.

Meeting Notes

■ The American Orthopsychiatric Association will hold its 33rd annual meeting at the Commodore and Roosevelt hotels in New York, 15–17 Mar. Orthopsychiatric theory and practice in five broad fields will be presented in approximately 65 papers by representatives of the wide range of professional disciplines in the field of orthopsychiatry. These broad fields include: schools and mental health; in-patient and out-patient psychiatric treatment of children; adolescence and juvenile delinquency; psychiatric clinic management; and adult psychotherapy. The opening presidential session will have as its keynote the "Challenge to orthopsychiatry; perspectives for the profession, for the community, and scientific and moral perspectives."

Twenty workshop sessions, with limited attendance provided for by advance registration, will offer opportunity for active participation of those attending. Selected mental health films will be shown for 2 days of the meeting. Technical and commercial exhibits related to the field will be on display. Inquiries about the program, reservations, exhibits, and other matters should be directed to Dr. Marion F. Langer, American Orthopsychiatric Association, 1790 Broadway, New York 19.

■ The sixth International Symposium on Combustion will take place at Yale University, 19 to 24 Aug. This is the first of these symposia to be held under the auspices of the new permanent organization, the Combustion Institute. All scientists and engineers interested in combustion and its applications are invited to participate.

Combustion in its broadest concept will be the theme of the symposium. Because of the accelerating growth of the field, the following comprehensive agenda is being considered: evaporation and combustion of droplets and fuel sprays; flammability, ignition, and quenching; structure and propagation of laminar flames; structure and propagation of turbulent flames; high-speed reactions, including detonation and shock-tube investigations; flame stabilization in fast streams; combustion of solid fuels; combustion of explosives and solid propellants; instability in combustion chambers; experimental and analytic techniques in combustion research, including optical methods, high-temperature measurement, fast-response instrumentation, and laws of similitude; safety and performance criteria in the design of combustion test facilities; applications of combustion, including combustion in reciprocating engines, combustion in gas turbines, chemical syntheses via combustion, physical processing via combustion, and fire extinguishing.

The papers sought are those containing new data, advances in theory and theoretical concepts, or new principles of engineering applications. Of the contributed papers, a certain fraction will be selected for actual presentation. Other contributed papers that are accepted will be read by title and published in the final volume.

To help communication between the authors and the audience, several new methods of presentation and discussion will be tried. Authors are requested to be governed by the following deadlines: titles, in triplicate, at any time; abstracts, in triplicate, *1 Mar.*; papers, in triplicate, *1 May*. For further information write to: The Combustion Institute, 200 Alcoa Bldg., Pittsburgh 19, Pa.

■ A symposium on Molecular Structure and Spectroscopy will be held in the department of physics and astronomy of Ohio State University 11–15 June. There will be discussion of the interpretation of molecular spectroscopic data as well as of methods for obtaining such data. In addition, there will be sessions devoted to the phases of spectroscopy that are of current interest.

A dormitory will be available for those who wish to reside on the campus during the meeting. For further information, or for a copy of the program when it becomes available, write to Prof. H. H. Nielsen, Department of Physics and Astronomy, Ohio State University, Columbus 10, Ohio.

The Joint Commission on Spectroscopy of the International Union of Pure and Applied Physics and the International Astronomical Union will meet in Columbus concurrently with the symposium.

■ The first International Congress of Developmental Biology will be held at Brown University, Providence, R.I., 23–26 July. It is sponsored by the International Institute of Embryology, which is a section of the International Union of Biological Sciences. The section will hold its triennial assembly at the time of the congress.

The organizing committee of the congress (Paul Weiss, chairman, and E. G. Butler, George W. Corner, Louis B. Flexner, J. S. Nicholas, B. H. Willier and J. Walter Wilson) has scheduled a program that includes two concurrent invitational symposia: "Regeneration in vertebrates" (organized by E. G. But-

ler); and "Embryonic nutrient requirements" (organized by J. S. Nicholas).

A day and a half will be given to the delivery of free papers by fellows and members of the IIE and by introduced speakers. Each member of the IIE may read a paper from the platform. Each fellow will be allowed two papers, one or both of which he may yield in favor of a speaker to be introduced by him.

The congress will be followed by a Symposium on Cytodifferentiation, sponsored by IUBS, 27–31 July. Active participation in this conference will be limited essentially to the members of the invited panel; the sessions, however, will be open to all registrants of the congress.

The registration fee for the congress will be $5. Brown University has offered the facilities of its new dormitories and dining halls for the accommodation of the participants at a flat rate of $7 per day for room and board to those who remain for the duration of the congress or the symposium or both. Applications for accommodations as well as inquiries about local arrangements should be sent to Prof. J. Walter Wilson, Department of Biology, Brown University, Providence, R.I.

Society Elections

■ New York Academy of Sciences: pres., Walter S. Root, Columbia University; pres.-elect, Ross F. Nigrelli, New York Zoological Park; cor. sec., Frederick C. Nachod, Sterling-Winthrop Research Institute, Rensselaer, N.Y.; rec. sec., Charles W. Mushett, Merck Institute for Therapeutic Research, Rahway, N.J.; treas., Richard O. Roblin, American Cyanamid Company, New York. The vice presidents are E. J. Kempf, Wading River, N.Y., and Boris Pregel, Canadian Radium and Uranium Corporation, New York.

■ AAAS, Southeast Branch, Alaska Division: pres., Donald Burrus, Alaska Native Arts and Crafts, Inc., Juneau; v. pres., Rosemary Allen, Alaska Territorial Museum, Juneau; sec.-treas., Leo M. Thompsen, P.O. Box 2211, Juneau.

■ Kentucky Academy of Science: pres., J. G. Black, Eastern Kentucky State College; pres.-elect., A. M. Wolfson, Murray State College; v. pres., Phil Miles, Kentucky Agricultural and Industrial Board; sec., Mary E. Wharton, Georgetown College; treas., R. A. Chapman, University of Kentucky. Representative to the AAAS Council is A. R. Middleton.

■ Phi Tau Sigma: pres., William B. Esselen, University of Massachusetts; v. pres., Carl S. Pederson, Cornell University; sec.-treas., Jean Caul, Arthur D. Little Co.

■ Ecological Society of America: pres., Henry J. Oosting; v. pres., W. Frank Blair; sec., John F. Reed, University of Wyoming; treas., Alexander C. Hodson. Representatives to the AAAS Council are William Hamilton and Murray F. Buell.

■ Society of American Foresters: pres., DeWitt Nelson, California Department of Natural Resources, Sacramento; v. pres., George A. Garratt, Yale University; exec. sec., Henry Clepper, 425 Mills Bldg., 17th St. at Pennsylvania Ave. NW, Washington 6, D.C.

■ Society of Rheology: pres., F. D., Dexter, Bakelite Company, Bound Brook, N.J.; 1st v. pres., J. H. Dillon, Textile Research Institute, Princeton, N.J.; 2nd v. pres., J. H. Elliott, Hercules Powder Company, Wilmington, Del.; sec.-treas., W. R. Willets, Titanium Pigment Corporation, 99 Hudson St., New York 13. Representatve to the AAAS Council is R. S. Spencer.

■ Sigma Delta Epsilon: pres., Mary Gojdics, Barat College; 1st v. pres., Irene Cory Diller, Institute for Cancer Research; 2nd v. pres., Mary Louise Robbins, George Washington University; sec., Helen Borton Parker, Lloyd Rd., R.D. 2, Malvern, Pa.; treas., Teresa Cohen, Pennsylvania State University. Representatives to the AAAS Council are Mildred Daniels Southwick and Emily T. Wolff.

Forthcoming Events

February

19–23. American Inst. of Mining and Metallurgical Engineers, New York, N.Y. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

19–23. Soc. of Economic Geologists, New York, N.Y. (O. N. Rove, Union Carbide and Carbon Corp., New York 17.)

20–22. American Educational Research Assoc., annual, Atlantic City, N.J. (F. W. Hubbard, AERA, 1201 16 St., NW, Washington 6.)

23–25. National Soc. of College Teachers of Education, Chicago, Ill. (C. A. Eggertsen, School of Education, Univ. of Michigan, Ann Arbor.)

24–25. American Physical Soc. Houston, Tex. (K. K. Darrow, APS, Columbia Univ., New York 27.)

26–29. American Inst. of Chemical Engineers, Los Angeles, Calif. (F. J. Van Antwerpen, AIChE, 25 W. 45 St., New York 36.)

28–29. Scintillation Counter Symposium, 5th, Washington, D.C. (G. A. Morton, RCA Laboratories, Princeton, N.J.)

March

2–4. National Wildlife Federation, New Orleans, La. (C. H. Callison, 232 Carroll St., NW, Washington 12.)

3–4. National Conf. and Workshop on Radio and Television Weather Presentation sponsored by American Meteorological Soc., Hartford, Conn. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

9–10. Midwest Conf. on Theoretical Physics, Iowa City, Iowa. (J. M. Jauch, Dept. of Physics, State Univ. of Iowa, Iowa City.)

12–16. National Assoc. of Corrosion Engineers, 12th annual, New York, N. Y. (Secretary, NACE, Southern Standard Bldg., Houston 2, Tex.)

14–17. National Science Teachers Assoc., Washington, D.C. (R. H. Carleton, NSTA, 1201 16 St., NW, Washington 6.)

15–16. Food Physics Symposium, 1st international, San Antonio, Tex. (C. W. Smith, Southwest Research Inst., San Antonio.)

15–17. American Orthopsychiatric Assoc., 33rd annual, New York, N.Y. (M. F. Langer, AOA, 1790 Broadway, New York 19.)

15–17. American Physical Soc., Pittsburgh, Pa. (K. K. Darrow, APS, Columbia Univ., New York 27.)

15–17. Kappa Delta Pi, annual, Stillwater, Okla. (E. I. F. Williams, 238 E. Perry St., Tiffin, Ohio.)

16–18. International Assoc. for Dental Research, St. Louis, Mo. (D. Y. Burrill, 129 E. Broadway, Louisville 2, Ky.)

17–18. National Soc. of Professional Engineers, annual spring, Washington, D.C. (K. E. Trombley, NSPE, 1121 15 St., NW, Washington 5.)

18–24. American Soc. of Photogrammetry, annual, joint meeting with American Cong. on Surveying and Mapping, Washington, D.C. (ACSM–ASP, Box 470, Washington 4.)

19–21. Div. of Fluid Dynamics, American Physical Soc., Pasadena, Calif. (F. N. Frenkiel, Applied Physics Lab., Johns Hopkins Univ., 8621 Georgia Ave., Silver Spring, Md.)

19–22. American Acad. of General Practice Scientific Assembly, 8th annual, Washington, D.C. (AAGP, Broadway at 34th, Kansas City 11, Mo.)

19–22. Inst. of Radio Engineers National Convention, New York. (E. K. Gammett, IRE, 1 E. 79 St., New York 21.)

19–23. American Soc. of Tool Engineers, Chicago, Ill. (H. C. Miller, Armour Research Foundation, 35 W. 33 St., Chicago 16.)

21–22. National Health Forum, New York, N.Y. (T. G. Klumpp, National Health Council, 1790 Broadway, New York 19.)

21–23. American Power Conf., 18th annual, Chicago, Ill. (R. A. Budenholzer, Illinois Inst. of Technology, Chicago 16.)

21–24. American Astronomical Soc. Columbus, Ohio. (J. A. Hynek, McMillin Observatory, Ohio State Univ., Columbus.)

23–24. Eastern Psychological Assoc., Atlantic City, N.J. (G. G. Lane, Univ. of Delaware, Newark.)

24–25. American Psychosomatic Soc., 13th annual, Boston, Mass. (T. Lidz, APS, 551 Madison Ave., New York 22.)

24–31. Perspectives in Marine Biology, La Jolla, Calif. (A. A. Buzzati-Traverso, Scripps Institution of Oceanography, La Jolla.)

25–28. American Assoc. of Dental Schools, annual, St. Louis, Mo. (M. W.

McCrea, 42 S. Greene St., Baltimore 1, Md.)

25–29. American College Personnel Assoc., Washington, D.C. (Miss C. M. Northrup, Univ. of Denver, Denver, Colo.)

28–3. Colloquium on Frontiers in Physical Optics, Boston, Mass. (S. S. Ballard, Visibility Laboratory, Scripps Institution of Oceanography, San Diego 52, Calif.)

29–31. Pennsylvania Acad. of Science, Indiana. (K. Dearolf, Public Museum and Art Gallery, Reading, Pa.)

29–31. Southern Soc. for Philosophy and Psychology, Asheville, N.C. (J. E. Moore, Georgia Inst. of Technology, Atlanta.)

29–31. Symposium on Fundamental Cancer Research, 10th annual, Houston, Tex. (G. Taylor, Univ. of Texas Postgraduate School of Medicine, Houston 25.)

30–31. Alabama Acad. of Science, annual, Montevallo. (H. A. McCullough, Howard College, Birmingham, Ala.)

April

2–5. Assoc. of American Geographers, annual, Montreal, Canada. (B. W. Adkinson, Library of Congress, Washington 25.)

2–7. Symposium on Crystallography, Madrid, Spain. (M. Abbad, Serrano 118, Madrid.)

3. Microcirculatory Conf., 3rd, Milwaukee, Wis. (G. P. Fulton, Dept. of Biology, Boston Univ., 675 Commonwealth Ave., Boston 15, Mass.)

3–9. International Symposium on Macromolecular Chemistry, Rehovoth, Jerusalem, and Haifa, Israel. (A. Katchalsky, Weizmann Inst. of Science, Rehovoth.)

4–6. American Assoc. of Anatomists, annual, Milwaukee, Wis. (N. L. Hoerr, 2109 Adelbert Rd., Cleveland 6, Ohio.)

4–7. International Cong. of Medical Radiography, 2nd, Paris. (The Congress, Via Nazionale 200, Rome, Italy.)

5–6. Conf. on Magnetic Amplifiers, Syracuse, N.Y. (C. A. Priest, 314 Hurlburt Rd., Syracuse 3.)

5–7. Optical Soc. of America, Philadelphia, Pa. (A. C. Hardy, Room 8–203, Massachusetts Inst. of Technology, Cambridge 39.)

6–7. American Assoc. of University Professors, St. Louis, Mo. (R. E. Himstead, AAUP, 1785 Massachusetts Ave., NW, Washington 6.)

6–7. National Speleological Soc., Nashville, Tenn. (Mrs. L. Cutler, 2829 Buchanan St., Arlington 6, Va.)

6–8. American Assoc. of Physical Anthropologists, Chicago, Ill. (J. L. Angel, Daniel Baugh Inst. of Anatomy, Jefferson Medical College, Philadelphia 7, Pa.)

7–8. American Soc. of Hospital Pharmacists, Detroit, Mich. (Miss G. Niemeyer, 2215 Constitution Ave., NW, Washington 7.)

8. American College of Apothecaries, Detroit, Mich. (R. E. Abrams, Hamilton Court, Philadelphia 4, Pa.)

8–10. American Assoc. of Colleges of Pharmacy, Detroit, Mich. (R. A. Deno, College of Pharmacy, Univ. of Michigan, Ann Arbor.)

8–13. American Chemical Soc., Dallas, Tex. (A. H. Emery, ACS, 1155 16 St., NW, Washington 6.)

8–13. American Pharmaceutical Assoc., annual, Detroit, Mich. (R. P. Fischelis, APA, 2215 Constitution Ave., NW, Washington 7.)

9–11. American Assoc. of Feed Microscopists, annual, Terre Haute, Ind. (R. C. Wornick, Agricultural Research Dept., Chas. Pfizer & Co., Inc., Terre Haute.)

9–12. International Anesthesia Research Soc., 30th annual cong., Miami Beach, Fla. (R. J. Whiteacre, 13951 Terrace Rd., Cleveland 12, Ohio.)

10–11. Symposium for Management on Applications of Analog Computers, Kansas City, Mo. (O. Fanning, Midwest Research Inst., 425 Volker Blvd., Kansas City 10.)

14. South Carolina Acad. of Science, annual, Clemson, S.C. (H. W. Freeman, Univ. of South Carolina, Columbia.)

15–16. American Soc. for Artificial Internal Organs, Atlantic City, N.J. (P. F. Salisbury, Cedars of Lebanon Hospital, 4751 Fountain Ave., Los Angeles 29, Calif.)

15–20. American Soc. for Pharmacology and Experimental Therapeutics, Atlantic City, N.J. (C. C. Pfeiffer, Emory Univ. School of Medicine, Emory University, Ga.)

15–21. American Inst. of Nutrition, Atlantic City, N.J. (R. W. Engel, Virginia Polytechnic Inst., Blacksburg.)

15–21. American Physiological Soc., Atlantic City, N.J. (M. O. Lee, 9650 Wisconsin Ave., NW, Washington 14.)

15–21. American Soc. for Experimental Pathology, annual, Atlantic City, N.J. (C. C. Erickson, 858 Madison Ave., Memphis, Tenn.)

15–21. Federation of American Societies for Experimental Biology, Atlantic City, N.J. (M. O. Lee, 9650 Wisconsin Ave., NW, Washington 14.)

16–18. Aero Medical Assoc., 27th annual, Chicago, Ill. (J. P. Marbarger, Aeromedical and Physical Environment Lab., Univ. of Illinois, Chicago.)

16–19. Conf. on Communication of Information by Workers Studying Sounds of Biological Significance, University Park, Pa. (H. Fringa, Dept. of Zoology and Entomology, Pennsylvania State Univ., University Park.)

16–20. American Assoc. of Immunologists, Atlantic City, N.J. (F. S. Cheever, Graduate School of Public Health, Univ. of Pittsburgh, Pittsburgh 13, Pa.)

16–20. American Soc. of Biological Chemists, Atlantic City, N.J. (P. Handler, Dept. of Biochemistry, Duke Univ., Durham, N.C.)

18–20. American College of Allergists, 12th annual, New York, N.Y. (F. W. Wittich, 401 La Salle Bldg., Minneapolis 2, Minn.)

18–19. National Industrial Research Conf., Chicago, Ill. (J. J. Kowal, Armour Research Foundation, Illinois Inst. of Technology, 10 W. 35 St., Chicago, 16.)

19–21. Assoc. of Southeastern Biologists, Durham, N.C. (J. C. Dickinson, Univ. of Florida, Gainesville.)

19–21. Ohio Acad. of Science, 65th annual, Springfield. (R. W. Dexter, Kent State Univ., Kent, Ohio.)

20–21. Iowa Acad. of Science, Grinnell. (J. L. Laffoon, Iowa State College, Ames.)

20–21. Nebraska Acad. of Science, 66th annual, Lincoln. (M. Beckmann, Univ. of Nebraska, Lincoln.)

22–26. American Ceramic Soc., 58th annual, New York, N.Y. (C. S. Pearce, 4055 N. High St., Columbus 14, Ohio.)

23–25. American Oil Chemists' Soc., 47th annual spring, Houston, Tex. (W. Argue, Anderson Clayton Co., Houston.)

23–25. National Acad. of Sciences, annual, Washington, D.C. (NAS, 2101 Constitution Ave., Washington 25.)

23–26. American Assoc. of Petroleum Geologists, annual, Chicago, Ill. (R. H. Dott, Box 979, Tulsa, Okla.)

23–26. International Acad. of Proctology, 8th annual teaching seminar, Chicago, Ill. (IAP, 147–41 Sanford Ave., Flushing, N.Y.)

24–25. International Acad. of Pathology, 45th annual, Cincinnati, Ohio. (F. K. Mostofi, Armed Forces Inst. of Pathology, Washington 25.)

24–27. American Industrial Hygiene Assoc., annual, Philadelphia, Pa. (G. D. Clayton, 14125 Prevost, Detroit 27, Mich.)

25–27. Symposium on Nonlinear Circuit Analysis, II, 6th international, New York, N.Y. (Polytechnic Inst. of Brooklyn, Microwave Research Inst., 55 Johnson St., Brooklyn 1, N.Y.)

26–28. American Assoc. of Pathologists and Bacteriologists, Cincinnati, Ohio. (E. A. Gall, Cincinnati General Hospital, Cincinnati 2.)

26–28. American Physical Soc., Washington, D.C. (K. K. Darrow, APS, Columbia Univ., New York 27.)

26–28. Kansas Acad. of Science, annual, Winfield. (C. T. Rogerson, Dept. of Botany, Kansas State College, Manhattan.)

26–29. American Psychoanalytic Assoc., Chicago, Ill. (J. N. McVeigh, 36 W. 44 St., New York 36.)

26–29. Wilson Ornithological Soc., Buffalo, N.Y. (P. B. Street, Rt. 1, Chester Springs, Pa.)

27–28. Colorado–Wyoming Acad. of Science, annual, Golden, Colo. (O. W. Olsen, Colorado A & M College, Fort Collins.)

28–5. International Conf. on Health Education, 3rd, Rome, Italy. (L. Viborel, International Union for Health Education of the Public, 92, rue Saint Denis, Paris, 1er, France.)

29–3. Semiconductor Symposium of Electrochemical Soc., 4th annual, San Francisco, Calif. (J. W. Faust, Jr., Westinghouse Research Laboratories, Beulah Rd., Churchill Borough, Pittsburgh 35, Pa.)

29–3. Soc. of American Bacteriologists, annual, Houston, Tex. (J. H. Bailey, Sterling-Winthrop Research Inst., Rensselaer, N.Y.)

29–3. Southwestern and Rocky Mountain Div., AAAS, annual, Las Cruces, N.M. (F. E. E. Germann, Dept. of Chemistry, Univ. of Colorado, Boulder.)

29–4. Soc. of Motion Picture and Television Engineers, 79th, New York, N.Y. (SMPTE, 55 W. 42 St., New York 36.)

30–2. American Geophysical Union, annual, Washington, D.C. (W. E. Smith, AGU, 1530 P St., NW, Washington 5.)

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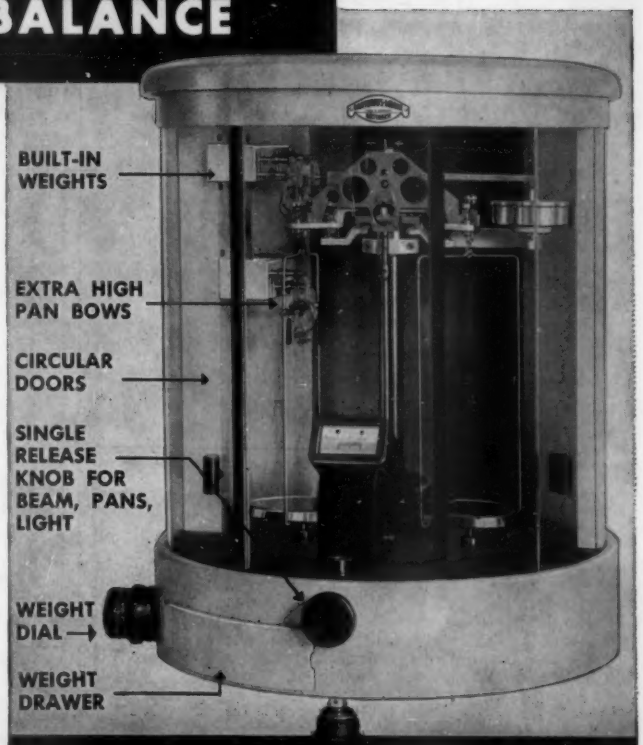

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